Moving Toward International Marine Conservation:

An Analysis of the Current Conservation Efforts, Threats, and International Agreements Governing Conservation in the Gulf of Mexico

by

Kyle Ruby Strongin

A Dissertation Presented in Partial Fulfillment
of the Requirements for the Degree
Doctor of Philosophy

Approved April 2021 by the
Graduate Supervisory Committee:

Beth Polidoro, Chair
Steven Saul
Leah Gerber

ARIZONA STATE UNIVERSITY

May 2021

ABSTRACT

Marine ecosystems are currently being impacted by various threats; however, quantification of the impacts of known threats and the population status of species are often conducted at different scales, depending upon stakeholder needs. Global-scale species assessments can mask the impact of local or regional threats within the context of global conservation priorities even as conservation policies are generally implemented at the local or regional scale. This work aims to identify the regional threats currently impacting species present within the Gulf of Mexico as well as the current polices addressing those threats. Species currently impacted by threats were used to build an ecosystem model to estimate food web dynamics in the Gulf of Mexico. This model is the first of its kind to incorporate data from more than 1500 species occurring in the Gulf including all marine bony shorefishes, marine reptiles, complete clades of select marine invertebrates, marine birds, marine mammals, and chondrichthyans. Comprehensive analyses of these groups are important for an improved understanding of the functioning of the Gulf of Mexico food web and the impact of identified threats on food web dynamics. The identification of current threats and food web dynamics will help to inform conservation policy moving forward. Properly framed conservation efforts are more likely to be widely accepted and successful when there is an improved understanding on how policies can impact stakeholders both economically and through changing practices. Finally, an investigation of the legal frameworks currently recognized in the Gulf of Mexico was done to build an example tri-national framework between the United States, Mexico, and Cuba focusing on current conservation gaps allowing for specific regional conservation concerns to be addressed.

ACKNOWLEDGMENTS

I am extremely grateful to my supervisors, Dr. Beth Polidoro, Dr. Steven Saul, and Dr. Leah Gerber for their invaluable advice, continuous support, and patience during my PhD study. They graciously offered me many opportunities for learning and collaboration which made this dissertation possible. I will always be thankful for the time, knowledge and experience which has encouraged me throughout this process. I would also like to thank Dr. Kent Carpenter and all the members of the Marine Biodiversity Unit at Old Dominion for their knowledge and support during my study. They graciously shared their time and expertise to help me understand the Red List process and the importance of GIS work to conservation. I would also like to thank IUCN without which many of the analyses conducted in this research would not have been possible.

Finally, I would like to express my gratitude to my husband, my children, and my parents. The time, effort, and energy needed to be a mom, a spouse, and a student was only made easier with their love, understanding, and encouragement. Without their tremendous understanding and encouragement, the completion of my studies would not have been possible. I truly hope my efforts will show my boys that anything is possible if you put your heart in it. I would like to extend a special thanks to my grandpa who always taught me to never stop learning and exel at everything I do; I wish you were here so I could share this with you. Thank you to all my previous instructors that encouraged me to always learn more and dream big.

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PREFACE

Marine biodiversity loss over the last century is just beginning to be understood. When records began in 1950s, the recorded landings were between 10-20mt (million tonnes). These steadily increased and peaked around 1996 at 86mt. However, these data only took into account commercial landings, defined as the fish which are caught and processed for sale. This does not include discarded species, bycatch, or the catch of small-scale, artisanal fisheries. So, if this information is included in the data, the actual numbers show a catch in 1950 of around 30mt (with a maximum of ~50mt), and the peak in 1996 was around 130mt (with a maximum of ~180mt) (Pauly & Zeller, 2016). These catches represent apex predators, like tuna and sharks, various billfish, to salmon, sardines, shrimp, cod, crab, lobster, and squid. Using the same time period, beginning in 1950, 366 fisheries have collapsed out of the around 1500 currently operating. This equates to the global loss of one in four stocks (Mullon et al., 2005). Many of these collapses were initially linked to severe weather events, like El Nino (Pauly et al., 2002). However, the data shows many collapses can and have happened suddenly (Mullon et al., 2005). Policies relating to marine conservation need to reflect the reality of this and other threats currently impacting marine ecosystems.

This study will focus on current conservation trends, efforts, and policies in the Gulf of Mexico Large Marine Ecosystem (LME). Various forms of conservation in the Gulf of Mexico have been increasing over the last few decades. Organizations such as the Nature Conservancy and the Gulf of Mexico Alliance have set up working groups and associated restoration projects to bring awareness to issues currently affecting the region. Chapter 1 focuses on a regional analysis of species extinction risks which helped to

identify current regional threats to marine species. The species identified in Chapter 1 were used to build a Gulf of Mexico food web model in Chapter 2. This model will provide a way to better understand how threats and management efforts affect species both directly and indirectly through food web interactions. An understanding of food web interactions is important because current research shows that Ecosystem Based Management (EBM) offers a more holistic approach to conservation over traditional single species models (CITE). This holistic approach must incorporate the direct and indirect effects of threats to species, but also include policies that address these threats at a regional level. Chapter 3 explores the current conservation policies of the United States, Mexico, and Cuba at both the national and regional levels. Gaps in conservation policy were identified and a model trinational conservation agreement proposed. Through a better understanding of current threats, ecosystem interactions, and policy, conservation efforts can be more clearly directed to address both ecosystem functioning and stakeholder interests.

CHAPTER 1

TRANSLATING GLOBALLY THREATENED MARINE SPECIES INFORMATION INTO REGIONAL GUIDANCE FOR THE GULF OF MEXICO

Abstract

A comprehensive understanding of the status of marine organisms in the Gulf of Mexico is critical to the conservation and improved management of marine biodiversity in the region. Threats and extinction risk, based on application of the IUCN Red List Categories and Criteria at the global level, were analyzed for 1,300 Gulf of Mexico marine species. These species include all known marine mammals, sea birds, marine reptiles, cartilaginous fishes, bony shorefishes, corals, mangroves, seagrasses and complete clades of select invertebrates. Analyses showed that 6% of these species are threatened, 2% Near Threatened, 9% Data Deficient, and 83% Least Concern. However, the majority of these species are not endemic to the Gulf, and therefore are globally impacted by threats that may or may not be particularly intense within the Gulf. For example, many of these species are impacted by fisheries in much of their global range; however, the intensity of fishing pressure varies across their ranges, and some of these exploited species are well managed in the Gulf of Mexico. Other anthropogenic impacts, including industrial development, pollution, and habitat loss also vary in intensity across species' global ranges. Here we provide recommendations for interpreting the application of global IUCN Red List Categories at the sub-global/regional scale, while highlighting conservation measures needed for marine species specific to the Gulf region.

1 | Introduction

The ongoing loss of marine biodiversity due to threats such as overfishing, coastal development, pollution and climate change, is negatively affecting ecosystem function and associated ecosystem services across the globe (Balvanera et al., 2006; Gamfeldt et al., 2008; Halpern et al., 2008; Hooper et al., 2012). It has become increasingly important to monitor the impact of anthropogenic stressors on marine biodiversity and ecosystems, including improved tracking of fisheries catch statistics (Coleman and Williams, 2002; Bache, 2003; Shirley et al., 2010; Barron, 2012; Pauly and Zeller, 2016). Species-specific extinction risk assessments can provide detailed information on the status of species' global and regional populations (Carpenter et al., 2008, Polidoro et al., 2010; Collette et al., 2011, Short et al., 2011, Polidoro et al., 2012; Polidoro et al., 2017; Linardich et al., 2018; Buchanan et al., 2019). The application of the IUCN Red List of Threatened Species methodology to create species-specific extinction risk assessments is a globally accepted, standardized tool for identifying the impacts of threats to populations (de Grammont and Cuarón, 2006; Hoffmann et al., 2008; IUCN, 2012a; IUCN, 2012b). These assessments not only identify those species most at risk of extinction, but also help define pathways toward sustainable management, reducing biodiversity loss and preserving ecosystem function (Klein et al., 2008).

The spatial distribution and intensity of threats can vary widely across a species range, especially for marine species with widespread distributions extending over many governmental jurisdictions, which often differ in preferences, practices, capacity, and cultural norms (Bolten et al., 2011; Senko et al., 2011; Lascelles et al., 2014). As conservation actions are typically implemented at the local or regional scale, the

utilization of global level threat and risk information to inform conservation and management practices needs further resolution to capture local or regional differences in the severity and impact of threats (Broennimann et al., 2006; Mace et al., 2008; Bolten et al., 2011). In order to support more effective conservation planning and identification of research priorities, additional species-specific information on extinction risk, population trends, and the impact of regional threats are needed (Polidoro et al., 2012; Polidoro et al., 2017).

The Gulf of Mexico (hereafter referred to as "the Gulf") is a primarily subtropical, large marine ecosystem bordered by the United States, Mexico, and Cuba in which marine species are facing threats such as overfishing, habitat loss, and pollution (Adams et al., 2004).The global conservation status of more than 2,000 marine species that occur in the Gulf is now publically available through IUCN Red List assessments. These include all known marine vertebrates, as well as species in selected, complete clades of marine invertebrates and marine plants. This study aims to translate 1,300 of these global level extinction risk assessments into recommendations for regional conservation action by analyzing the severity of global vs. regional threats. Quantifying and comparing the severity of global and regional threats on marine populations in the Gulf of Mexico will allow for better informed decision making when implementing regional conservation strategies, as well as identifying critical research needs.

2 | Methods

2.1 | Definition of Geographic Range

The Gulf of Mexico is defined according to boundaries described by Felder et al. (2009), which extend from the southern tip of Florida to northwest Cuba and the northern

tip of the Yucatan Peninsula and encompass an area of about 1,554,000 km^2. The Gulf is the ninth largest body of water in the world and is as a semi-enclosed basin or marginal sea consisting mainly of subtropical habitats bordered on all sides by primarily continental land masses except in the south where it is connected to the Caribbean Sea and flows outwards towards the Bahamas through the Florida Strait in the north (GNIS 2000).

2.2 | Taxonomic Inclusion

A comprehensive species list was compiled for marine vertebrates (e.g. marine bony fishes, sharks and rays, marine mammals, marine reptiles), some groups of marine invertebrates in complete taxonomic clades (e.g. cone snails, cephalopods, sea cucumbers, and lobsters), and habitat-building species (e.g. mangroves, reef-building corals and seagrasses) that are both present in the Gulf of Mexico and have been globally assessed for the IUCN Red List of Threatened Species. Species lists were derived by querying the IUCN Red List website (www.iucnredlist.org) for all assessed marine species in the above taxonomic groups having an occurrence in the United States, Mexico, or Cuba and then culling species that do not occur within the Gulf of Mexico. Assessments for the deep sea bony fishes, those species occurring primarily in pelagic waters off the continental shelf and below 200m, were not available at the time of the initiation of this study, and were therefore not included.

The list of sea birds was initially created using the GulfBase database (http://biogomx.org/). This initial list was revised by following the definition of a sea bird according to Birdlife International (Croxall et al., 2012). To be considered for inclusion, a large portion of the bird's population must utilize the marine environment for resources

or have a large role in the marine ecosystem food web for at least part of the year to be considered a true sea bird. This reduced the sea bird list to a total of 45 species, including species such as pelicans, while excluding species such as the Trumpeter Swan.

2.3 | IUCN Species Assessment Process

Data collection for Red List assessments of marine fishes of the Gulf of Mexico was overseen and conducted by the Marine Biodiversity Unit at Old Dominion University between 2012-2015. Data and assessments for all other groups were overseen by a variety of IUCN Species Survival Commission Species Specialists Groups (https://www.iucn.org/ssc-groups). The application of the IUCN Red List Categories and Criteria (IUCN, 2012a) during these assessments is described in additional detail in the Supplemental Online Material. The process begins with the collation of scientific articles, grey literature, and direct input from species' experts, on life history, habitats and ecology, distribution, population trends, threats, and conservation measures for each species. A digital range map is also produced as part of the assessment process. These data are then reviewed by species experts and assigned an IUCN Red List category based on application of the standardized criteria. A species is listed in a threatened category, as Vulnerable, Endangered, or Critically Endangered, only if certain quantitative thresholds and conditions are met. If these criteria are not met, a species can be listed as either Least Concern or Data Deficient depending on the amount of data currently available. Any species that nearly meets the quantitative threshold and conditions for inclusion in a threatened category is listed as Near Threatened. A species may also be listed as Extinct in the Wild or Extinct if extensive surveys indicate that no extant individuals remain in wild populations or if surveys fail to record any remaining individuals in the wild or in

captivity. Once the peer review process is completed, the final assessments are made publicly available on the IUCN Red List website (www.iucnredlist.org).

2.4 | Threat Analyses

Species-specific data were compiled from the Red List assessments, including taxonomy, habitat, life history, threats, and distribution. Only the 79 species listed in a threatened category (Table 2) were analyzed for threat impacts, as threats are not required for species listed as Data Deficient (DD) or Least Concern (LC) (IUCN, 2013). In Red List assessments, threat categories follow the classification scheme developed by Salafsky et al. (2008). The threat categories extracted from the 79 threatened species assessments were simplified to Aquarium Trade, Bycatch, Disease, Directed Fishing, Habitat Loss, Hunting and Predation, Industrial Development, Invasives, Pollution, Storms, and Warming (Table 1). The threats impacting these species were then compared at a regional vs. global scale to help define why protections are recognized in one region and not in another. The overall impacts from threats for each species was designated as either the 'same', 'more', or 'less' in the Gulf as compared to outside according to text within the Red List assessment. If the listed threats were equally impacting areas both outside and inside the Gulf, threat impacts were coded as 'same' across the species' range. If the majority of listed threats were considered stronger in the Gulf, then the overall severity of threats was coded as 'more' severe in the Gulf. If the listed threats occurred only or to a greater extent in areas outside the Gulf region, threats were considered stronger outside the Gulf than inside, and consequently coded as 'less' severe in the Gulf. Current species listings from the IUCN Red List, the US Endangered Species Act, and the Mexico NORMA 59 were also compared to show differences in

currently recognized threats at both the regional and global levels, and to compare protections which may exist both inside and outside the Gulf.

2.5 | Statistical and Spatial Analyses

Species distribution maps were created in ArcGIS using protocols created by the IUCN Marine Biodiversity Unit or the respective protocols of individual species specialist groups such as those for birds or marine mammals. Species inhabiting coastal areas/continental shelf were clipped to a shoreline buffer of 100 km or a depth of 200 m, whichever was further from the coast. Ranges for pelagic species and species with poorly described ranges were drawn based on points from museum collections, as well as known and inferred occurrences. All maps were then clipped to the Gulf of Mexico region and converted to 5 km by 5 km raster grids which were then overlaid and added together to calculate species richness. This process was done for all species, and separately for threatened species and for DD species.

3 | Results

3.1 | Species Extinction Risk in the Gulf of Mexico

Of the 1,301 species (Table S1, Supplemental Online Material), 6% (79 species) are listed in one of the three threatened categories (VU, EN, or CR). More than 75% (7 of 9 species) of marine reptiles are listed in a threatened category, which represented the largest threatened percentage out of all the clades analyzed. Almost 20% (5 of 27 species) of marine mammals are listed in a threatened category. Of the 941 marine bony fishes, 39 species, or 4%, are listed in a threatened category. Of the 45 seabirds, two, or 0.04%, are listed in a threatened category. Thirteen of the 83 chondrichthyan species, 16%, are listed in a threatened category. Three of the 122 non-coral invertebrates, or 0.02%, are listed in

a threatened category, including two cone snails and one horseshoe crab. Lastly, 10 of the 75 habitat-building species (e.g. corals, mangroves and seagrasses), 13%, are listed in a threatened category (Table 2). Factors such as taxonomic confusion and lack of population data led to 9% (113) species being listed as Data Deficient. Species were generally listed as Data Deficient due to taxonomic confusion, lack of key life history information that can inform the impact of known threats, or lack of population data to adequately quantify the impact of known threats. This lack of data can be due to collection difficulty, low sampling effort and/or insufficient data on habitat decline or fisheries catch and effort. For example, several Data Deficient species are only known from the holotype.

3.2 | Threats to Marine Species in the Gulf of Mexico

The five most common threats to species in the Gulf are Directed Fishing, Habitat Loss, Industrial Development, Pollution and Bycatch (Figure 1). Almost half (37 of 79) of all threatened species in the Gulf are impacted by directed fishing, including 20 of the 39 threatened bony fishes and all of the threatened sharks and rays. Approximately half of all threatened bony fishes are also impacted by habitat loss, primarily those that are dependent upon seagrass, coral or estuarine habitats for some or all of their life stages. Additionally, approximately one-quarter of threatened bony fishes are also impacted by the invasive lionfish, *Pterois volitans/miles* complex.

All five of the sea turtle species present in the Gulf are impacted by habitat loss, industrial development, incidental capture as bycatch, and hunting. Similarly, all nine threatened coral species are impacted by increased sea surface temperatures (warming), and other oceanographic changes which can cause an increased incidence of disease

(Brodnicke, 2019). The five threatened marine mammals present in the Gulf are globally impacted by bycatch, industrial development and pollution. These results are consistent with those of Linardich et al. (2018) who found that smaller bodied bony shorefishes were more likely to be impacted by habitat loss while larger bodied species were more likely to be impacted by exploitation. Additional information on examples of threatened species in the Gulf within each taxonomic group, along with their global Red List Categories, can be found in the Supplemental Material.

3.3 | Comparison of Global and Regional Threats

In general, more than one-third (26 of 79 species) of IUCN listed threatened species were less impacted by threats in the Gulf when compared to threats outside the Gulf, while only 10% (9 of 79 species) were more impacted by threats occurring within the Gulf (Table 3). The threat levels for 44 species were found to be the same as elsewhere across their global range. In order to determine which globally threatened species have also been recognized as regionally threatened under national regulations, the 79 IUCN threatened species were compared with those species protected regionally by either the US Endangered Species Act (ESA) (1973) and/or the Mexico NORMA 59. Although the lack of consistency across protections is likely due to large differences in assessment processes, more than 70% (57 of 79 species) of species listed in an IUCN threatened category were not designated as threatened, and therefore not protected, under either the ESA or NORMA 59 (including 2 species Under Review). Within these, none of the 14 Gulf endemic IUCN threatened species is protected by either the US ESA or NORMA 59, although 1 species is currently under review (*Fundulus jenkinsi*). A comparison of the severity of regional vs. global threats to species listed on either or both

the ESA and NORMA 59, shows that 9 of these 22 species are facing the same level of threat across the entirety of the species range both inside and outside the Gulf. The level of threat within the Gulf was less for 12 species when compared to the level of threat faced outside the Gulf. Only one species, the Nassau Grouper (*Ephinephelus striatus*), had experienced higher levels of threat (e.g. due to fishing) within the Gulf, due to historical exploitation of spawning aggregations that have not recovered (Ault et al., 2013; Aguilar-Perera & Tuz-Sulub, 2012).

3.4 | Spatial Analyses

The Florida Keys have the highest species richness within the Gulf of Mexico (Figure 2a). Both Threatened and Data Deficient species richness is also concentrated around the Florida Keys, the northern and western side of the Yucatan Peninsula, and the eastern coast of Mexico (Figure 2b,c). Many of the Data Deficient species occur in the southern and eastern Gulf, mainly Cuba and Mexico, where more sampling effort and fisheries information is needed.

4 | Discussion

4.1 | Threatened Species

This is the first study to examine the conservation status and associated threats of all Red List comprehensively assessed clades of marine species across the Gulf of Mexico. Other regional, comprehensive studies of marine biodiversity extinction risk and patterns of threat have been conducted in the Persian Gulf (Buchanan et al., 2019), the Eastern Central Atlantic (Polidoro et al., 2017) and the Eastern Tropical Pacific (Polidoro et al., 2012). Although comprehensive species groups included in each study varied, with only 6% (79 of 1,301 total species) of species being listed in a threatened category in the

Gulf of Mexico, this percentage is less than that in the Eastern Tropical Pacific (12%) and the Eastern Central Atlantic (9%). A recent study of the greater Caribbean (Linardich et al., 2018) found that 65 of the 1,360 bony shorefishes (5%) there were listed in a threatened category, and 34 of the 940 bony shorefishes (4%) that occur in the Gulf of Mexico were listed in a threatened category at the Gulf regional-level.

4.2 | Data Deficient Species

There are a variety of factors that can lead a species to be listed as Data Deficient, including taxonomic confusion, the lack of species-specific data in aggregate population trend information, and the lack of information on the impact of known threats. Twelve of the 27 marine mammals present in the Gulf of Mexico were listed as Data Deficient. Species such as *Balaenoptera edeni*, the Bryde's Whale, and *Orcinus orca*, the Killer Whale, have taxonomic confusion and possible subspecies groups, making it difficult to assess the impact of threats and the current population status of distinct species due to conflicting data. Thirty-five bony fishes, 35 chondrichthyans, and 22 marine invertebrates were also listed as Data Deficient due to taxonomic confusion and/or lack of information to adequately quantify the impact of known threats. The Southern Eagle Ray, *Myliobatis goodei*, is listed as Data Deficient because it is commonly caught as bycatch, but the impacts on its population are unknown. Nine of the 22 marine invertebrates listed as Data Deficient, such as *Helicocranchia papillata (*Siphonate cranch squid), *Sandalops melancholicus* (Sandal-eye squid), and *Holothuria arenicola* (Sand sea cucumber) are also lacking population data due to taxonomic confusion. These species highlight the importance of continued research on taxonomy, population, and the impact of known threats on many marine species. In addition, efforts are needed to educate resource users,

managers, field data collection staff, and the public on proper identification of important species in the region (Chizinski et al., 2014).

4.3 | Translating global extinction risk categories into regional conservation priorities

Translating the Red List assessment of a species, that is not endemic to a certain management locality, such as a countries' jurisdiction or a marine protected area, can be problematic. For example, a widespread species can still be listed as threatened based on population decline data that has been averaged across its global range, even if some regional or local populations may be stable or increasing. In contrast, a species can be globally listed as Least Concern, but have populations in smaller portions of its range that are in decline or even extirpated. For these reasons, prioritization of conservation actions at the regional scale for globally threatened species must consider: 1) the efficacy of any regional or local protections for species that may provide for improved population stability, 2) the severity of major threats to the species within the region of interest, compared to those threats operating elsewhere, and 3) the connectivity of populations within and outside the area of interest, in order to account for any rescue or sink effects. Threats such as hunting, collection for the aquarium trade, and predation are likely of lower intensity within the Gulf, compared to outside regions, primarily due to improved regulations. Species such as the Sei Whale, Blue Whale, Right Whale, and the Loggerhead, Green, Kemp's Ridley, and Leatherback Sea Turtles, have faced high levels of global exploitation in the past century, but their protected status under ESA or NORMA 59 most likely allows these species to have a higher opportunity for recovery at least in U.S. and/or Mexican waters. Unfortunately, details of biological connectivity between populations inside and outside the Gulf are generally not known for the vast

majority of marine species. Of the 79 threatened species, 17 are currently recognized on the ESA or NORMA 59 as needing some level of protection. For example, sea turtles are mainly impacted by illegal hunting and poaching outside of the Gulf region (Campbell, 2003; Garcia-Martinez & Nichols, 2000; Senko et al., 2011), and sea birds are primarily impacted by rat predation (Jones et al., 2008), which is a threat to nesting populations on islands outside the Gulf region. For the other 62 threatened species, a closer look at the severity of threats affecting their Gulf populations (Table 3) may help prioritize species and geographic areas for conservation and further research, and may identify threat mitigation strategies.

Globally pervasive threats such as disease, invasive species, storms and increased ocean warming are growing in severity in many parts of the world. For example, increased storm activity, ocean warming, and ocean acidification are linked to global climate change (Leiserowitz et al., 2013).The projected increased intensity and frequency of storms is estimated to have a negative impact on coral species almost everywhere (Pandolfi et al., 2011; De'ath et al., 2012). Globally, coral communities are also experiencing an increased threat from marine diseases (Harvell et al., 1999; Weil et al., 2006). Although little may be known about the causes or mode of their transmission (Richardson, 1998), human related threats, such as pollution and habitat degradation, in combination with changes in oceanographic conditions related to climate change, are thought to increase the incidence of these diseases (Ruiz-Morenol et al., 2012; Osterhaus, 1995). Similarly, the invasive lionfish, which can drive biomass declines in small-bodied reef fishes, is rapidly expanding its range throughout the Gulf of Mexico, the Caribbean and Western Atlantic (Johnston & Purkis, 2015; Côté & Smith, 2018). Further discussion

is warranted for the top five threats to marine species in the Gulf of Mexico (Directed Fishing, Habitat Loss, Industrial Development, Pollution and Bycatch), particularly as there are likely certain cases where these threats may be more severe in the Gulf compared to other adjacent regions in the Caribbean and Western Atlantic. Therefore, improved management and mitigation of these threats should be a priority for the conservation of threatened marine species in the Gulf of Mexico.

4.3.1 | Threats from Fisheries

Fisheries in the Gulf currently target high-value species such as groupers, snappers, and tunas, which are also of interest to artisanal and recreational fisheries. In U.S. waters, management of these fisheries is prescribed in the Magnuson-Stevens Act (MSA). Since the implementation of the MSA, the status of fisheries stocks in U.S. waters has improved, with nearly 90% of all U.S. managed fisheries maintained at sustainable levels. Although the Mexican National Fisheries Institute has recommended management to prevent collapse of fisheries (Castillo-Geniz et al., 1999), including increasing mariculture to supplement supply in the face of decreasing fish stocks, many concerns remain, including barriers to full reporting, mostly open access fisheries, poor administrative practices, and corruption (Cisneros-Montemayor et al., 2015). In addition, industrialization has created well-equipped fleets that are continually subsidized, further endangering stocks in the region. Similarly, in Cuba, management plans and incentives exist to limit harvests, particularly for shark fisheries, but the efficacy of these actions is not known (NPOA-Sharks, 2015).

Since 1983, the United States-Mexico Fisheries Cooperation Program has encouraged bilateral communication and cooperation on the protection of endangered

species and the management and enforcement of some recreational and commercial fisheries. However, it does not address issues where conflicts of interest between the two countries may exist (NOAA, 2017), which can facilitate the continued decline in stocks and loss of biodiversity. Although these programs are important steps forward, overfishing and illegal fishing is still occurring, including in marine protected areas (Mangin et al., 2018; Pala et al., 2018). Estimates show that the Gulf is severely overfished due to illegal and unreported catches, so increased regulation will be necessary to improve the health of Mexico's fish stocks (Cisneros-Montemayor et al., 2013; Espinoza-Tenorio et al., 2015). The need for better management plans in Cuba is supported by catches which have been declining for the last 30 years, with more than 18% of catches from 1950-2009 going unreported. In addition, changing political environments and associated policies have also led to most Cuban fish stocks being considered fully- or over-exploited (Au et al., 2014).

4.3.2 | Threats from Habitat Degradation

Habitat degradation continues to be an issue impacting many species globally (Hoekstra et al., 2005). Although there are 295 marine protected areas in the Gulf of Mexico, comprising 112,600 km^2 (UNEP-WCMC, 2018), or about 7% of total marine waters in the Gulf, extensive coastal development and shoreline modification continue to impact species dependent on sensitive, near-shore environments, such as seagrass and estuarine habitats. These species may be experiencing more severe impacts from habitat loss and degradation compared to outside of the Gulf, especially in the northern Gulf of Mexico (Short & Wyllie-Echeverria, 1996; Waycott et al., 2009; Archambault et al., 2018). Between 1930 and 1990, more than 3,900 km^2 of coastal habitat has been lost in

the Mississippi River Delta alone (Boesch et al., 1994), due in part to the construction and maintenance of levees and dams for flood control and maintenance channels for boat traffic (Dahl & Stedman, 2013). With more than 50 million people living along the Gulf of Mexico coastline, near-shore habitats are often the most severely degraded (Halpern et al., 2008). Current recommendations for preventing and mitigating further habitat loss in these areas include ecosystem restoration, sediment management, and re-vegetation (Barry et al., 2015).

4.3.3 | Threats from Industrial Development

Activities such as industrial drilling and dredging can permanently change habitats, often resulting in the most severe forms of modification and destruction (Jetz et al., 2007). Petrochemical drilling has the potential to release trapped chemicals and gasses into the environment, while dredging can significantly change topography in ways that eliminate prior habitats and ecosystems. Compared to the Caribbean, industrial development in the Gulf of Mexico is estimated to be more severe, especially in the northern Gulf where the oil and gas industry has had a major influence on ecosystem modifications (Turner & Rabalais, 2019). However, impacts to species threatened by tourism within the Gulf of Mexico are likely to be less than other areas outside the Gulf, such as in the Caribbean. Historically, tourism in the region has been driven by the development of resort areas (Mendoza-Gonzalez et al., 2012), which has been closely linked to habitat loss (Sevilla et al., 2019) and has been established on a much larger scale in the Caribbean as compared to the Gulf.

4.3.4 | Threats from Pollution

Pollution within the Gulf of Mexico is comparable to levels in the Greater Caribbean and Western Atlantic (Hyland et al., 2003; Jambeck et al., 2015). Although natural petrochemical seeps are present within the Gulf of Mexico, hundreds of minor and major petrochemical accidents and spills have occurred over the past several decades (Turner & Rabalais, 2019). The two largest spills, the 2010 Deepwater Horizon and the 1979 Ixtoc I oil spills, impacted coastlines from Mexico to Texas to Florida, including many populations of marine mammals, sea birds, fishes, invertebrates, and habitat building species (Biello, 2010; DeLeo et al., 2015).

The outflow of nutrients and agrochemicals from the Mississippi River is another major source of pollution in the Gulf, and leads to frequent, large-scale eutrophication events and anoxic zones in the northern Gulf (Mitsch et al., 2001). Although the effects of these hypoxic events on marine communities are not well-known, documented decreases in net surface productivity and deficiencies in benthic oxygen levels can significantly alter species composition and ecosystem function (Atwood et al., 1994; Diaz & Solow, 1999; Davis, 2017).

4.3.5 | Threats from Bycatch

Bycatch rates within the Gulf of Mexico are similar to those outside the Gulf (Davies et al., 2009). Various regulations have been put into place in recent years to decrease the impact that bycatch is having on non-targeted populations. In U.S. waters, policies are in place to reduce the impact of bycatch; however these policies have not fully addressed this bycatch issue. For example, shrimp trawling activities catch juvenile reef fish in their operations, especially red snapper and gray triggerfish, killing many

newly recruited animals (Diamond, 2004). Sharks and turtles are also still regularly caught as bycatch. Atlantic Bluefin Tuna, which are already at very low population levels, get caught in pelagic longline gear. Since Bluefin are entering the Gulf to spawn, any significant rates of bycatch can be disruptive to spawning activities (Beerkircher et al., 2009). Longline fishing is also one of the leaders in bycatch of sea birds and sharks. In 2008, the United States became a member of the Agreement on the Conservation of Albatrosses and Petrels. This international agreement between 13 other member nations which has yet to be signed by the United States, requires seabird mitigation devices on all longlines (Audubon, 2017).

4.4 | Comparing Regional vs. Global Listings

The threats mentioned in the previous sections are those most likely to impact a broad range of species groups in the Gulf. However, given that there are at least 57 species, including *Alopias superciliosus* (Bigeye Thresher Shark), *Balistes capriscus (*Gray Triggerfish), and *Epinephelus morio* (Red Grouper) which are listed in an IUCN threatened category and are not protected by either the ESA or NORMA 59, it is important to understand differences in criteria and the listing process for IUCN vs. ESA and NORMA 59. The IUCN Red Listing process aims to systematically assess the status of all valid species in a given taxonomic group against the same set of Criteria, by meeting or exceeding established quantitative thresholds of decline in population or range size. By contrast, the ESA listing process is based on petitioning for species of special interest to be listed, through the presentation of scientific information as it relates to five factors that have unspecified quantitative thresholds.

The current management and commercial importance of species is also taken into consideration by the ESA; species that are considered to have insufficient regulatory mechanisms can be considered for listing (Sullins, 2001). This differs from the IUCN listing process, which is only concerned with quantifying past, present or future decline under a known threat, regardless of current management and/or commercial importance. For example, biomass for the Gray Triggerfish (*Balistes capriscus*), which is currently managed as a single stock in the northern Gulf, has declined from 63-68% over the past 3 generations or 12-14 years (Liu et al., 2015), is listed as VU under IUCN Criterion A2bd, but may not be petitioned for listing under the US ESA since current management strategies could be seen as sufficient. These differences in listing processes and criteria also mean that the impacts of regional and global threats may be quantified differently. For consistency, the IUCN also supports regional applications of the IUCN Red List methodology (IUCN, 2012b), which essentially follows the same global listing process, but takes into account the connectivity of regional populations with non-regional populations for the purposes of accounting for source or sink population dynamics.

5 | Conclusion

The most significant threats to marine species in the Gulf are directed fishing, habitat loss, industrial development, pollution and bycatch. Several species groups are also impacted by threats that are pervasive across the globe, including increased sea surface warming, storms, invasive species and increased incidence of disease. Regardless, global level extinction risk assessments need to be used in combination with regional knowledge of already existing protections and information on the severity of known threats operating within the area of management interest. This is especially important

when the connectivity between regional populations and those outside the region is not known. By integrating information on regional protections and the severity of regional threats, global-level extinction risk assessments can be used to inform local or regional scale conservation initiatives. Specifically, they can identify species or geographic areas where further research is needed on globally threatened species populations and/or on the severity of threats.

Conservation priority species, such as those listed under the U.S. Endangered Species Act and the Mexico NORMA 59, highlight those species at greatest risk in the Gulf. However, as this study has shown, many species that are listed in a threatened category at the global scale are not recognized by regional conservation efforts, even when threats within the Gulf are the same as across their global range or even increased in severity within the Gulf. This is of most concern for 13 of the 14 Gulf endemic IUCN threatened species that are not protected by either the ESA or NORMA 59. This data is important to future conservation measures as it provides a comprehensive summary of those species currently in need of additional regional protections. By also addressing those threats that are currently having a greater impact in the region, management strategies can provide a better framework for rebuilding impacted populations. These differences in regional and global conservation assessment processes and threatened status should not be ignored, but rather embraced, as they can identify critical needs for further research and action to conserve regional populations of globally threatened species.

Table 1: Definitions of threat categories.

Threat Category	**Definition**
Aquarium Trade	Includes those species thought to be impacted by the aquarium trade.
Bycatch	Includes species caught as bycatch in commercial industries as well as entanglement in ghost nets or pots.
Disease	Includes species currently being impacted by diseases.
Directed Fishing	Includes those species which are the focus of targeted fishing efforts.
Habitat Loss	Includes those species whose ranges are declining due to declining habitat availability.
Hunting and Predation	Limited to marine turtles and birds which are impacted by hunting efforts for their shells and eggs, and predation of seabird populations by rats.
Industrial Development	Includes species thought to be impacted by tourism, dredging, shipping, and drilling.
Invasives	Includes species thought to be impacted by invasive species.
Pollution	Includes runoff, eutrophication, chemical/oil spills, and noise pollution.
Storms	Limited to species whose habitats and/or migration routes can be impacted by tropical storms
Warming	Includes ocean warming, bleaching events, and migratory or habitat movements due to changing water temperatures.

Table 2: Red List status by taxonomic group

Taxonomic Group	LC	DD	NT	VU	EN	CR	Total Species
Mangroves & Seagrasses	12	1	1	1			15
Reef-Building Corals	42	8	1	5	2	2	60
Gastropods	27	1		2			31
Lobsters, Horseshoe Crabs	19	2		1			22
Cephalopods	30	13					43
Sea Cucumbers	20	6					26
Sharks	14	11	10	7	2		44
Rays, Skates, Sawfishes	7	23	2	2		2	36
Chimaeras	1	1	1				3
Bony Fishes	856	35	11	29	9	1	941
Reptiles	2			4	1	2	9
Seabirds	42		1	1	1		45
Marine Mammals	10	12		3	2		27
Grand Total	**1082 (83%)**	**113 (9%)**	**27 (2%)**	**55 (4%)**	**17 (1%)**	**7 (0.05%)**	**1301**

Table 3: Comparison of species status on IUCN Red List, US ESA, and Mexico NORMA 59. Abbreviations are as follows: (CR) - Critically Endangered, (EN) or (E) - Endangered, (VU) - Vulnerable, (T) - Threatened, (SP) - sujeta a proteccion especial (special protection), (PE) - peligro de extincion (in danger of extinction), (UR) - Under Review. * Endemic Gulf species.

Genus species	Common Name	Global RL	ESA	NORMA 59	Aquarium Trade	Bycatch	Disease	Fishing	Habitat Loss	Hunting	Industrial Development	Invasives	Pollution	Predation	Storms	Warming	Strength of Threats in Gulf Compared to Globally
Acropora cervicornis	Staghorn Coral	CR	T	SP			x							x	x	x	Same
Acropora palmata	Elkhorn Coral	CR	T	SP			x							x	x	x	Same
Agaricia lamarcki	Lamarck's Sheet Coral	VU	-	-			x				x					x	Same
Alopias superciliosus	Bigeye Thresher Shark	VU	-	-		x		x									More
Alopias vulpinus	Common Thresher Shark	VU	-	-		x		x									Same
Balaenoptera borealis	Sei Whale	VU	E	SP		x											Less
Balaenoptera musculus	Blue Whale	EN	E	SP									x			x	Less
Balistes capriscus	Gray Triggerfish	VU	-	-				x									More
Carcharhinus longimanus	Oceanic Whitetip Shark	VU	-	-				x									More
Carcharhinus obscurus	Dusky Shark	VU	-	-		x		x									More
Carcharhinus plumbeus	Sandbar Shark	VU	-	-				x									More
Carcharias taurus	Sand Tiger Shark	VU	-	-		x		x									Same
Caretta caretta	Loggerhead Sea Turtle	VU	T	PE		x	x		x	x	x		x				Less
Chelonia mydas	Green Sea Turtle	EN	T	PE		x		x	x	x	x						Less
Conus anabathrum*	Florida Cone	VU	-	-							x						Same
Conus stearnsii*	Cone Snail sp.	VU	-	-					x		x						Same
Coryphopterus eidolon	Pallid Goby	VU	-	-								x					Same
Coryphopterus hyalinus	Glass Goby	VU	-	-	x							x					Same
Coryphopterus lipernes	Peppermint Goby	VU	-	-					x			x					Same
Coryphopterus personatus	Masked Goby	VU	-	-					x			x					Same
Coryphopterus thrix	Bartail Goby	VU	-	-					x			x					Same
Coryphopterus tortugae	Patch Reef Goby	VU	-	-					x			x					Same
Crocodylus acutus	American Crocodile	VU	T	SP					x	x	x						Less
Ctenogobius claytonia*	Mexican Goby	VU	-	-					x				x				Same
Dermochelys coriacea	Leatherback Sea Turtle	VU	E	PE		x	x		x	x	x		x				Less

Dichocoenia stokesii	Elliptical Star Cone	VU	-	-			x				x				x	x	Same
Elacatinus jarocho*	Jarocho Goby	EN	-	-					x		x						Same
Elacatinus prochilos	Broadstripe Goby	VU	-	-					x				x				More
Epinephelus itajara	Atlantic Goliath Grouper	VU	-	-				x					x				Less
Epinephelus morio	Red Grouper	VU	-	-				x					x				More
Epinephelus striatus	Nassau Grouper	CR	T	-				x	x		x	x					More
Eretmochelys imbricata	Hawksbill Sea Turtle	CR	E	PE		x			x	x	x						Less
Eubalaena glacialis	North Atlantic Right Whale	EN	E	PE		x					x		x				Less
Fundulus grandissimus*	Giant Killifish	VU	-	-					x				x				Same
Fundulus jenkinsi*	Saltmarsh Topminnow	VU	UR	-					x								Same
Fundulus persimilis*	Yucatan Killifish	EN	-	-					x				x				Same
Halichoeres burekae*	Mardi Gras Wrasse	EN	-	-							x	x	x				Same
Halophila baillonii	Clover Grass	VU	-	-									x		x		Less
Hippocampus erectus	Lined Seahorse	VU	-	SP	x	x		x	x				x				Same
Hypoplectrus castroaguirrei*	Veracruz White Hamlet	EN	-	-					x		x	x	x				Same
Hyporthodus flavolimbatus	Yellowedge Grouper	VU	-	-				x									Less
Hyporthodus niveatus	Snowy Grouper	VU	-	-				x									Less
Isurus oxyrinchus	Shortfin Mako	VU	-	-				x									Same
Kajikia albida	White Marlin	VU	-	-				x									Same
Lachnolaimus maximus	Hogfish	VU	-	-				x	x		x						Same
Lepidochelys kempii	Kemp's Ridley Sea Turtle	CR	E	PE		x	x		x	x	x		x				Same
Limulus polyphemus	American Horseshoe Crab	VU	-	PE		x		x	x		x		x			x	Less
Lopholatilus chamaeleonticeps	Golden Tilefish	EN	-	-				x									Same
Lutjanus campechanus	Red Snapper	VU	-	-		x		x									Same
Lutjanus cyanopterus	Cubera Snapper	VU	-	-				x	x								Same
Makaira nigricans	Blue Marlin	VU	-	-		x		x									More
Malaclemys terrapin	Diamondback Terrapin	VU	-	-					x	x	x						Same
Manta birostris	Giant Manta Ray	VU	-	-		x		x									Less
Megalops atlanticus	Tarpon	VU	-	-				x	x		x		x				Same
Menidia colei*	Golden Silverside	EN	-	-					x				x				Same
Menidia conchorum*	Key Silverside	EN	-	-					x							x	Same
Mola mola	Ocean Sunfish	VU	-	-		x		x									Less
Montastraea annularis	Boulder Star Coral	EN	-	-			x									x	Less
Montastraea faveolata	Mountainous Star Coral	EN	-	-			x		x		x			x	x	x	Less
Montastraea franksi	Star Coral	VU	-	-			x		x		x			x	x	x	Same

Mycetophyllia ferox	Rough Cactus Coral	VU	T	-			x				x					x	Same
Mycteroperca interstitialis	Yellowmouth Grouper	VU	-	-				x									Same
Narcine bancroftii	Caribbean Electric Ray	CR	-	-		x		x									Same
Neoopisthopterus cubanus*	Cuban Longfin Herring	VU	-	-					x								Same
Oculina varicosa	Large Ivory Coral	VU	-	-							x						Less
Odontaspis ferox	Smalltooth Sand Tiger	VU	-	-				x									Less
Physeter macrocephalus	Sperm Whale	VU	E	SP		x							x				Less
Podiceps auritus	Horned Grebe	VU	-	-			x	x			x		x				Less
Pomatomus saltatrix	Bluefish	VU	-	-				x									Less
Pristis pectinata	Smalltooth Sawfish	CR	E	T		x		x									Less
Pterodroma hasitata	Black-capped Petrel	EN	UR	-					x		x			x			Same
Rhincodon typus	Whale Shark	EN	-	T		x		x									Less
Rhomboplites aurorubens	Vermilion Snapper	VU	-	-		x		x				x					Less
Sanopus reticulatus*	Reticulated Toadfish	EN	-	-					x		x		x				Same
Sphyrna lewini	Scalloped Hammerhead	EN	T	-		x		x									Same
Thunnus obesus	Bigeye Tuna	VU	-	-				x									Less
Thunnus thynnus	Atlantic Bluefin Tuna	EN	-	-				x					x			x	Same
Tigrigobius redimiculus*	Cinta Goby	VU	-	-			x		x			x					Same
Trichechus manatus	West Indian Manatee	VU	T	PE							x						Same

Figure 1: Threats affecting species in threatened categories according to IUCN Categories and Criteria.

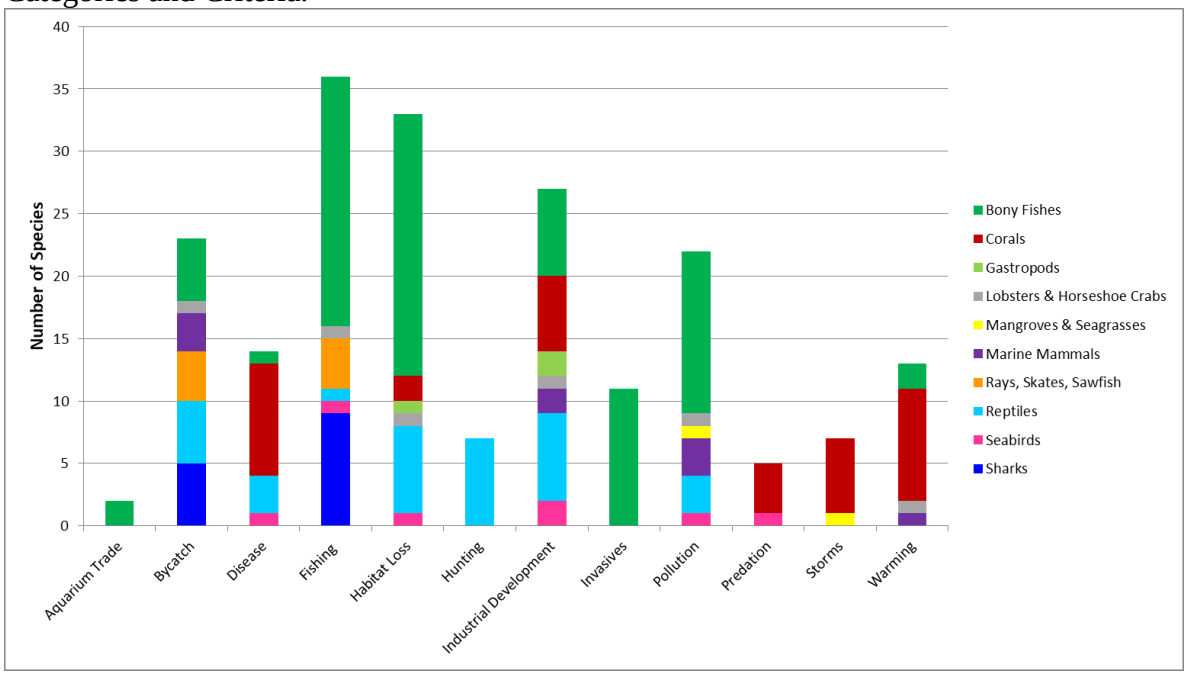
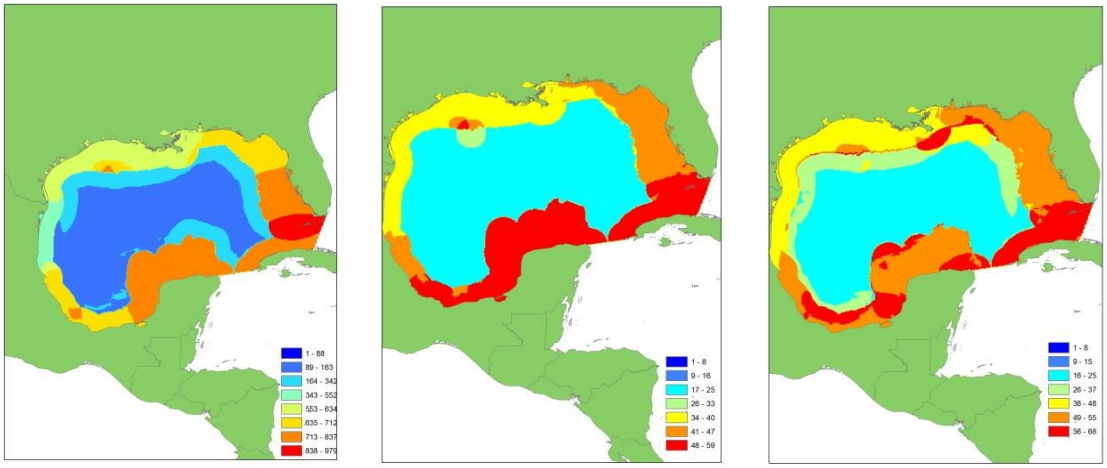


Figure 2: Spatial analysis of (a) total species richness; (b) threatened species richness including CR, EN, and VU species; (c) Data Deficient species richness.



CHAPTER 2

ECOPATH MODEL USING COMPREHENSIVE ESTIMATES OF BIOMASS FOR MARINE BIODIVERSITY ACROSS THE NORTHERN GULF OF MEXICO

Abstract

The holistic management of ecosystems and their associated resources have become more apparent over the last several decades. Relationships among various species are still poorly understood which makes predicting the impact of threats across an ecosystem hard to quantify. Various modeling programs are utilized to inform managers and guide decision making. Within marine ecosystems, most models only represent single species dynamics when predicting the impact of decisions regarding catch limits, gear restrictions, seasonality, and protected areas on commercial species. However, under this approach, the impact of management decisions across trophic levels is not well understood. In response, we developed a model of a representative marine food-web for the northern Gulf of Mexico comprising all major clades of marine organisms using the mass balance approach found in Ecopath with Ecosim. Inclusion of marine fishes, birds, reptiles, invertebrates, and mammals allows for a better understanding of the complex dynamics occurring in the marine ecosystem. Estimates of biomass were provided for 832 bony fishes, 79 chondrichthyans, 39 birds, 27 mammals, 5 sea turtles, and 1095 invertebrates allowing for more accurate estimates of Production, Consumption, and Ecotrophic Efficiency to be generated. The model will be used in future studies to evaluate the impact of threats experienced in the Gulf of Mexico including fishing, oil exploration, and invasive species on food-web dynamics. Results will inform local or

regional scale conservation initiatives enabling managers to identify species or groups at greatest risk.

1 | Introduction

Marine ecosystems provide essential services and resources for humans across the globe. However, the increase in global dependence on marine resources, especially over the last several decades, has greatly impacted the biodiversity of these systems (Levin & Lubchenco, 2008). According to Walters et al. (1997), fisheries scientists now agree on the need for whole ecosystem management approaches to regulations as opposed to traditional single-species management. This idea was further laid out in the United Nation's Millennium Ecosystem Assessment, which introduced the idea of forming policy based on social-ecological systems. However, the complexity of these systems has made this a difficult task (Carpenter et al., 2009). Changes to ecosystem assemblages can impact multiple species interactions, in addition to altering ecosystem functioning (Dulvy et al., 2003; Ives & Carpenter, 2008). For example, commercially important species, can also be one of the most important forage items for species like birds and marine mammals providing a critical energy link between upper and lower trophic levels (Geers et al., 2016; Pikitch et al., 2012). Ecosystem modeling has been used as a way to better understand these interactions and the impacts that various threats will have on the connectivity of ecosystems and ecosystem functioning.

Ecosystem models, like Ecopath and Ecosim, have become important tools for understanding a wide range of ecological questions (Christensen & Walters, 2004; Geers et al., 2016). These models allow for the creation of an artificial ecosystem where the effects of various threats and inputs can be tested (Nival & Raybaud, 2007). Several

ecosystem-based models have been built focusing on specific threats operating in portions of the Gulf of Mexico, such as the impacts of fishing activities on bony fish communities (Geers et al., 2016; Tarnecki et al., 2016; Sargarese et al., 2017). However, few models to date have represented the entire Gulf of Mexico ecosystem, nor have taken all known marine vertebrates and complete clades of invertebrates into consideration, including: bony fishes, marine mammals, marine birds, marine reptiles, invertebrate species, and chondrichthyans. The connections between these species across the Gulf are essential to understating the complexities within the marine food web and for estimating how specific threats will impact the ecosystem as a whole.

The purpose of this study was to build the first comprehensive marine food web model of the Gulf of Mexico. This model incorporates a variety of functional groups including marine birds, marine reptiles, marine mammals, invertebrates, and chondrichthyans. In addition, the data utilized in this model will be the most comprehensive estimate of biomasses of all functional groups currently available. In future studies, this working model can be used to show how threats such as commercial fishing and oil exploration impact the functional relationships and biomass pools within the Gulf of Mexico.

2 | Methods

2.1 | Model Description

Ecopath is a modeling program which provides a way to analyze the energy flow within an ecosystem utilizing a mass balance approach (Polovina, 1984; Christensen & Pauly, 1992; Pauly et al., 2000; Christensen & Walters, 2004; Christensen et al., 2008). Each ecosystem model consists of the major components of the ecosystem which are represented by modeled groups, known as functional groups, and can represent either a

single species or a group of similar species (based on life histories, habitats, diets, etc.) (Geers et al., 2016). The mass balance equation utilized in the Ecopath model is as follows:

(1) $B_i(P/B)_i \cdot EE_i - \Sigma_{j-1}Bj(Q/B)jDCij - Yi - E_i - BA_i = 0$

This equation describes production within the ecosystem where B_i is the biomass of prey item (i) and B_j represents the biomass of predator (j). The total mortality rate is represented by P/B or the ratio of production/biomass (Merz & Myers, 1998), EE_i is the ecotrophic efficiency, or the fraction of production that is utilized from the system, Q/B represents the food consumption per unit of biomass, and DC_{ij} is the fraction of prey item (i) to the diet of predator (j), Y_i is the total fisheries catch rate, E_i is the net migration rate, and BA_i is the biomass accumulation rate. Using the mass balance approach allows the model to estimate one of four missing parameters (B, P/B, Q/B, and EE) from the above equation if they are unknown (Geers et al., 2016). Once the production, biomass, and consumption estimates are available for each functional group within the ecosystem, a network of energy flows can be created.

The EwE model that was developed focused on species groups known to occur in the Gulf of Mexico which utilize the marine ecosystem for a large portion of their life histories. A total of 67 functional groups were created; and included marine mammals, sea birds, sea turtles, cartilaginous fishes, bony fishes, corals, mangroves and seagrasses, and select invertebrate groups (Table 4). The area modeled is the Northern Gulf of Mexico as defined according to boundaries set by the US Gulf of Mexico exclusive economic zone (EEZ), which extends from the southern tip of Florida west to southern Texas and encompasses an area of about 797,000 km^2.

The species list used in this study was based on a previous study consisting of 1302 individual species from 6 clades: marine mammals, bony fishes, marine reptiles, seabirds, invertebrates, and habitat building species; this list was obtained from Strongin et al. (2020) Additional species of invertebrates were included to account for functional groups such as sea cucumbers, jellyfish, lobsters and shrimps, gastropods, and bivalves which were not included in the scope of the previous study (Appendicies A-G). Within each clade, species were separated into functional groups based on similar life history characteristics, diets, and habitat preferences. Several individual species of either commercial or conservation interest were separated into their own functional group to highlight the impact of food web changes on these species. This resulted in a total of 67 functional groups including a group for meiobenthos and detritus (Table 4).

2.2 | Model Parameters

The mass balance approach in the Ecopath with Ecosim modeling program requires parameterization of three out of four parameters: Biomass, Production, Consumption, and Ecotrophic Efficiency (EE); the model estimates the fourth parameter.

2.2.1 | Biomass

The biomass (B) values used within the Ecopath model for each functional group were obtained from several locations. As defined above, the initial 1302 species were separated into functional groups. Several steps were used to develop input biomass estimates for each species, and thus each functional group. First, biomass estimates from stock assessments conducted for certain bony fishes and marine mammal species were used when available. When only raw numbers of individuals were reported, they were multiplied by average adult mass to provide an estimated biomass.

For many species, however formal stock assessments have never been conducted. As a result, we next considered existing survey databases that could inform biomass estimates. The National Resource Damage Assessment (NRDA) seabird surveys conducted between 2010-2011 by the National Oceanic Atmospheric Administration (NOAA) were used to estimate the biomass for seabirds in the Gulf by multiplying the number of sightings by average adult weight. The Southeast Area Monitoring and Assessment Program (SEAMAP) trawl surveys provided catch information for various species in both numbers of individuals caught and overall weight. The total area trawled during these surveys was calculated to be 1265.875km^2. The biomass per area of each species/km^2 was calculated by dividing the total trawled weight by the total trawled area. This number was then used to provide an estimate of total species biomass across the northern Gulf of Mexico EEZ by multiplying the biomass/km^2 by the size of the study area, 797,088.8842km^2. For the purpose of this study, equal distribution was assumed across the entire study area.

The SEAMAP trawl survey only samples those species that are susceptible to being captured using trawl gear, and those species that live in locations where the trawl survey operates. Trawl gear is restricted to operating over low relief habitat where it will not become caught; therefore, the survey only captures species that occupy trawlable habitats. In addition, trawling activity does not take place close to the shore, so nearshore species are also not well sampled.

For species with little or no data collected by the SEAMAP survey, data from the Ocean Biodiversity Information System (OBIS) was used. Most of the OBIS observations are made in nearshore regions, which is helpful to balance the offshore sampling done by the SEAMAP program. The OBIS program records numbers of individuals observed within

the known range of that species. The OBIS database provides GIS mapping tools for each species and associated sightings. Using R, all species GIS maps were downloaded and cut to the northern Gulf of Mexico. The sightings which occurred in this region for each species were multiplied by average adult weight to obtain the total biomass for that species within its range in the northern Gulf. Finally, previous Gulf of Mexico Ecopath models were used to estimate biomass for species where biomass estimates were otherwise unavailable (Walter et al., 2008; Castelblanco-Martinez et al., 2012; Geers et al., 2016). Once the biomass values for each species were calculated, all species in a given functional group were combined to represent the overall biomass of each functional group (Table 4; Appendicies A-G).

2.2.2 | Parameterization

Typical production to biomass ratio values (P/B), which are considered an estimate of the total mortality (Z), can range from 0.05 for slower growing organisms to 40 for more quickly growing organisms. Q/B values, which represent food consumption per unit of biomass, typically range from 1-100 but can be higher depending on the consumption of the defined functional group. Ecological efficiency (EE) values, representing the proportion of the production that is utilized within or caught from the system, must be below one since values over one represent a system which is utilizing more of a given resource than available (Pauly et al., 2000). Initial Production (P/B) and Consumption (Q/B) values in the model were obtained from current literature (Geers et al., 2016; Sagarese et al., 2017; Karim et al., 2019; Chagaris et al., 2020; Perryman et al., 2020). Ecotophic Efficiency (EE) was allowed to be estimated for most functional groups.

Species specific values of (P/B) and (Q/B) for species within a given functional group, were averaged to provide the model one estimate per functional group.

Dietary information for each functional group describing predator-prey interactions, and their relative strength were obtained from IUCN records, Fishbase, and current literature. A database of all species was created along with known dietary items as defined in literature. Each species was assigned to their respective functional group and the dietary items summed across all species. Once the diet for a species had been defined, this information contributed to the food web connections of the functional group to which each species was assigned.

2.3 | System Balancing

Ecopath is designed to calculate one of the four parameters when the other three are provided. Before the first run of the model, Biomass, Production, and Consumption, as calculated above, were included and Ecopath was allowed to estimate Ecotrophic Efficiency (EE) for each group. After the initial run, 20 groups were found to have an EE above one, representing that the predation pressure on the group is too high. Predation mortality rates estimated by Ecopath were used to guide adjustments made to the diet matrix. Once appropriate changes were made to the dietary matrix, adjustments were made to the biomass of various groups. Initial biomass estimates, as described above, were obtained from stock assessments, SEAMAP, NRDA, OBIS, and other Ecopath studies. However, due to the nature of sampling, species may not be accurately represented. For example, SEAMAP trawls were conducted in deeper shelf waters using 4m wide doors. These surveys were not conducted over rocky bottoms or deep reefs. Therefore, near shore species, as well as those commonly found on rocky bottoms or

deep reefs were under sampled. An example would be horseshoe crabs whose initial estimate based on survey numbers from both SEAMAP and OBIS was 1.11198^{-13} tons/km^2. However, other papers showed that this number should be significantly higher. Incremental adjustments were made by increasing the estimated B by a power of 10. When EE values dropped close to 1, smaller adjustments were made with a final estimated biomass value of 0.0015 tons/km^2 producing an EE of .977. This estimated biomass is much closer to numbers found in literature (Smith et al., 2017). Some species were oversampled by the different sampling programs. Lobster and shrimp species were initially estimated to be 1.5 tons/km^2. However, this estimate was found to be too large; adjustments were made and a final estimate of 1.35 tons/km^2 allowed for a decrease in EE values of lobster prey items such as small demersal fish and small reef fish. Finally, adjustments were made to (P/B) and (Q/B) values to address any groups that still had EE values over 1. This may have meant adjustments to associated predator or prey groups as the (P/B) or (Q/B) values of a predator group may have negatively impacted a prey group.

3 | Results

3.1 | Model Performance

For the purposes of this study, Ecopath was able to estimate EE for all but four functional groups: bivalves, plankton, red grouper, and seabirds. Instead, Ecopath calculated the biomass values for these groups since estimated biomass values were not able to be reliably determined for these groups. The final input variables utilized in the balanced model as well as the estimated parameters can be found in Table 5. The highest tropic level the model estimated was 4.07, which represented Large Sharks, followed by

Blacktip Sharks (3.825), and Marlins (3.809). The lowest tropic level was 1.0 for Algae, Detritus, Mangroves and Seagrasses, Meiobenthos, and Plankton. The average trophic level was 2.707. Calculated Ecotrophic Efficiency (EE) values ranged from 0.0037 for Black Drum to 0.9984 for Yellowfin Tuna. Ladyfish had the highest net efficiency value at 0.377556. All P/Q were within the 0.1 to 0.3 range typically seen in other models. Ratios for Respiration/Assimilation ranged from 0.6224 for Ladyfish to 0.9375 for Manatees. An Ecopath pedigree was not calculated for this study because the model was based on a virgin Gulf of Mexico ecosystem with no harvesting being considering at this time. The calculated Shannon Diversity index of the modeled community was found to be 1.6959 (Table 6).

Predation mortality rates per year are presented in Table 5. These mortalities can be linked to several of the above parameters which may be considered low due to the inability to determine the proportion individual species play in predator diets. For example, an EE value of 0.0037 and associated Predation Mortality of 0.000224 for Black Drums would be considered low when compared to other species at a similar trophic level. However, for the purposes of this model, Black Drums as an individual species were only included in the diets of Large Sharks because only adult members of each species were included within each functional group to maintain consistency across different clades and to reduce the overall number of functional groups.

3.2 | Analysis of Food Web

The food web diagram produced for this model can be seen in Figure 1. The largest energy flows occurred from the Plankton functional group to several groups including Mysticetes (Baleen whales), Small Pelagic Fish, and Crabs. The Small Pelagic Fish group

also provided large flows to higher functional groups which relied on it as a prey item. Eight distinct tropic levels (I to VIII) encompassing all functional groups are shown in Table 7. The transfer efficiencies (TEs) within this system, from primary producers was 11.54% and was 14.38% from detritus. Most of the flow within the system occurred between tropic levels I-III declining at higher levels.

3.3 | Mixed Trophic Impact

Ecopath results can be used to indicate both direct and indirect interactions the biomass of a group will have on other groups within a steady state system (Christensen et al., 2005). Both negative and positive impacts are seen across the modeled system (Figure 2). The groups which showed the most positive impacts on the most other groups included Plankton and Meiobenthos. Several other groups including Algae and Small Pelagic Fish also had a positive impact on several groups. Higher tropic level groups including Blacktip Sharks Large Pelagic Fish, and Large Sharks showed overall negative impacts to other groups. Interestingly, both the Crabs and Lobster/Shrimp groups showed a mixed positive and negative impact across all groups.

3.4 | Ecosystem Properties and System Statistics

The system statistics for the modeled Gulf of Mexico marine ecosystem are shown in Table 6. The calculated total system throughput (TST) was found to be 2826.219 t/km^2/year, where 1765.58 t/km^2/year came from exports, 50.74 t/km^2/year from respiration, and 925.60 t/km^2/year from flows into detritus. A value of 1899.26 t/km^2/year was calculated for Net System Production with a Total Biomass of 91.08 t/km^2. No calculation was done for Total Market Value, Total Shadow Value, Total Fixed Cost,

Total Variable Cost, Profit, or Ecopath Pedigree because this model was designed to represent a virgin system with no current pressure from fisheries included.

4 | Discussion

4.1 | Model Parameterization

The mass balance approach is used within the Ecopath Ecosim program to balance the biomass exchanges occurring within a given ecosystem. Ecotrophic Efficiencies were estimated for all but 4 functional groups since biomass estimates for this model were provided by recent data collected by trawling and visual surveys occurring in the Gulf of Mexico. Many of the EEs were lower than expected when compared to other studies (Geers et al., 2016; Sagarese et al., 2017; Karim et al., 2019; Chagaris et al., 2020; Perryman et al., 2020). Groups such as Gag Grouper (0.0126), King Mackerel (0.0223), and Scaled Sardine (0.0411) all had EE estimates below 0.05. Typical EEs would be much higher for these species: Gag Grouper (0.766), King Mackerel (.030565), and Scaled Sardine (0.70). The estimates within this study may have differed due to the biomass estimates, but more likely due to impacts from threats such as fisheries or species invasions which were not included in this model. These threats will be added in subsequent studies which will allow for the impacts to be observed across various functional groups.

When determining dietary proportion, many dietary studies are not able to identify down to the species level. Therefore, many items are identified at the Family or even Order leaving uncertainty in dietary preferences (Pacella et al., 2013; Bentley et al., 2019). This issue is compounded when individual species of either commercial or conservation importance constitute a single functional group. When considering individual species that

would have fallen into a much larger functional group, if no additional data was available, it was assumed that the species in question most likely made up 1% of predator diets at any given time. For example, when considering the dietary contribution scaled sardine would have played in a predator diet compared to a small pelagic fish, it was assumed that at any given time, scaled sardine could have constituted 1% of the predators' diet unless literature supported other conclusions. This decreased predatory pressure on certain groups combined with overall biomass estimates may have pushed the estimated EE values lower for this study.

Ecopath estimated the biomasses for four groups, Bivalves, Plankton, Red Grouper, and Seabirds. This was due to problems balancing the model when original biomass estimates for these three groups were utilized. Original estimates from NOAA and OBIS samples provided the following estimates: Bivalves (4.535^{-13}), Red Grouper (0.045), and Seabirds (0.00595). These numbers were assumed to be incorrect due to the location of the sampling, sampling gear type, and species habitat and range. First, much of the NOAA sampling was done in deeper, offshore waters with no bottom sampling which would have missed most Bivalves. Seabird samples were obtained from NOAA NRDA surveys (Haney et al., 2019). The purpose of these surveys was to identify Gulf of Mexico bird species. The numbers provided allowed for an estimate of seabird biomass, however based on the foodweb and other estimates used in Ecopath, the system was allowed to estimate the biomass so it would be a better representation of this system.

As previously mentioned, production and consumption values were obtained by averaging values from previous studies that were used for similar functional groups (Geers et al., 2016; Sagarese et al., 2017; Karim et al., 2019; Chagaris et al., 2020;

Perryman et al., 2020). Many groups required modification of these initial estimates to obtain model fit (Table 4). Several estimates, such as Cephalopods required decreases in both their P/B and Q/B values. This was most likely due to the biomass estimates within this model as well as the complexities of the associated food web. However, these changes were still within what is considered normal values for these groups and created P/Q ratios ranging between 0.05 (Manatees) to 0.302 (Ladyfish).

4.2 | Trophic Structure

The trophic structure created in any model is driven by the dietary interactions which are included in the dietary matrix, as discussed in O'Farrell et al. (2016). The complexity of dietary interactions in a natural system cannot be replicated in a modeling program which has been highlighted by other studies (Sagarese et al., 2017). The database created for this study attempted to highlight the main dietary connections existing between functional groups based on current data. Initially, dietary linkages proved to be very complex, as expected, leading to many EE values over one due to increased predation on certain groups. Modifications were made to dietary interactions by first removing dietary items that were only observed occasionally. This allowed for the EEs of several groups to fall below one. Next, predation rates as well as biomass estimates were adjusted for groups that were shown to have the greatest impact on the most number of functional groups according to the Predation Mortality Rates provided by Ecopath. The resulting food web shows that there are eight identifiable tropic levels. Species that would typically be considered predatory species are found toward the upper trophic levels, while species typically seen in predator diets are found in the middle tropic levels; grazers and

producers are found in the lower trophic levels providing an accurate representation of a simplified Gulf of Mexico food web.

4.3 | Biomass Estimates

The construction of any Ecopath model presents the issues of how to best obtain realistic biomass estimates for so many diverse groups, many with little or no population data available. Previous studies have relied on stock assessments, field surveys, or current literature for estimated biomass (Karim et al., 2019; Chagaris et al., 2020; Gomez, 2020; Perryman et al., 2020). These data will provide realistic biomass estimates for well studied or easily observed groups. However, our functional groups consisted of many lesser known species, many of which occurred offshore or in deeper waters. By combining OBIS sightings data and SEAMAP trawls, the biomasses of many of these species were able to be included in this study. For example, there are 15 known Lutjanid species occurring in the northern Gulf of Mexico and by combining data from SEAMAP and OBIS, this study was able to produce biomass estimates for all 15 species. Similarly, there are 97 included eel species, 38 included estuarine species, and 46 included flatfish species of which this study provides biomass estimates for 83/97 eels, 32/38 estuarine fish, and 45/46 flatfish respectively. In total, biomass estimates were provided for 832 bony fishes, 79 chondrichthyans, 39 birds, 27 mammals, 5 sea turtles, and 1095 invertebrates allowing for a more representative biomass estimate to be utilized (Appendicies A-G). We did not separate species into age classes in our study, as others have.

4.4 | Future Applications

The inclusion of ecosystem based management practices has become more common over the last several years (Fulton et al., 2013; Chagaris et al., 2015; Arreguin-Sanchez et al., 2017; Delacamara et al., 2020). Various regulatory measures including top-down, incentive based, user or community based, and spatial management practices have all been proposed in various forms with no consensus on the best path forward (Hilborn, 2007; Fulton et al., 2010; Tam et al., 2017; Alexander et al., 2019). It will be important to future ecosystem-based research and management planning to create ecosystem models which better represent specific ecosystems or regions and the threats impacting those species. For example, fishing and/or fishing practices were highlighted in several studies, including those for bony fishes and marine mammals, as posing an impact to marine species (Adams et al., 2004; Archambault et al., 2018; Strongin et al., 2020). Comprehensive trophic models such as the one created for this study can be used as a baseline ecosystem to analyze the ecosystem wide impacts from various threats. In current literature, many models have been used to observe the effects of various changes to fisheries practices, such as changes to management practices, catch limits, spatial or temporal closures, and bag or size limits (Collie et al., 2016; Kvamsdal et al., 2016; Hornborg et al., 2019; Weninger, 2019). These studies typically will include the species of interest and prey items, but may be limited to the number of additional functional groups considered due to lack of information or the scope of interest of the given study. This practice may provide information important to the specie(s) of interest, but fails to highlight the impacts to other species which are trophiclly linked but not included in the model (Massoud et al., 2018). We propose that ecosystem based management (EBM)

strategies require the use of a model representative of an ecosystem in order to properly observed bottom-up and top-down effects to determine best practices moving forward. In order to view the impacts of EBM, the framework of the above model will be expanded to include an Ecosim and Ecospace component. This will allow for the inclusion of changes in seasonality, changes in immigration and emigration patterns, definition of species ranges, habitat mapping, and defining of marine protected areas (MPAs) within the modeling space.

The main threats to species in the Gulf of Mexico have been identified as directed fishing, habitat loss, industrial development, pollution, and bycatch (Strongin et al., 2020). The incorporation of these threats into an Ecopath with Ecosim model will allow for development of a more holistic approach to management. Successful ecosystem management will require the implementation of a suite of strategies that take into consideration both the direct and indirect effects of threats to marine ecosystems (Tam et al., 2017; Levin et al., 2018; Massoud et al., 2018; Delacamara et al., 2020; Piet et al., 2020). Previous studies have done well in identifying the direct impacts of various threats, but the impact of indirect threats on trophiclly linked species is poorly understood (Jacob et al., 2020). The use of this model or one similar will highlight those changes to functional groups which may have not been previously identified.

Table 4: Functional Groups, beginning values based on previous literature, and final mass balanced values utilized in Gulf of Mexico Ecopath model.

Group name	Biomass (t/km^2) Start	Biomass (t/km^2) Finish	P/B Start	P/B Finish	Q/B Start	Q/B Finish
Algae	30.0000	30.0000	27.5000	27.5000		
Atlantic Bluefin	0.0062	0.0062	0.9400	0.8900	3.4000	8.0000
Atlantic Croaker	0.3000	0.3001	1.5000	1.5000	10.0000	10.0000
Barracuda	0.3047	0.0015	1.3200	1.2000	7.0000	4.0000
Bay Anchovy	0.4503	0.0098	2.5300	4.0000	14.0000	18.0000
Benthic Feeding Sharks	0.0650	0.0650	0.4700	0.4700	6.5387	3.0000
Bivalves		0.0038	1.2090	2.4000	23.0000	10.0000
Black Drum	0.2500	0.0250	0.5780	0.5780	3.6540	3.6540
Blacktip Sharks	0.0110	0.0110	0.4000	0.4000	2.0000	2.0000
Catfish	0.2541	0.1000	0.8000	0.9000	7.6000	5.0000
Cehpalopods	0.7000	0.0900	4.1910	1.9000	26.0083	7.0000
Crabs	2.3000	1.0000	2.3400	2.3400	10.1372	9.5000
Deep Water Fish	0.0042	0.0420	1.3000	1.3000	4.8000	4.8000
Detritus		1.0000				
Eels	2.5008	0.0315	1.0000	0.8000	4.5000	3.1000
Estuarine Fish	0.0003	0.0300	0.9224	1.3000	8.1472	6.1472
Filter Feeding Sharks	0.1017	0.1017	0.7555	0.7555	8.1525	7.0000
Flatfish	0.2120	0.2120	0.4500	0.4500	5.1872	4.0000
Gag Grouper	0.0532	0.0532	0.4580	0.4580	7.1472	3.0000
Gastropods	0.5000	0.5000	2.3500	2.3500	13.3500	13.3500
Greater Amberjack	0.0298	0.0298	1.1000	0.9000	3.6000	4.0000
Groupers	0.0922	0.0922	0.4580	0.4580	6.4581	3.0000
Horseshoe Crabs	0.0000	0.0015	0.7000	1.6000	5.0000	5.6000
Jacks	0.0015	0.1490	0.8000	1.1640	9.7682	7.7682
Jellyfish	0.0000	0.0490	19.3333	4.4000	50.6667	15.0000
King Mackerel	0.0159	0.0159	2.3500	2.3500	39.5667	10.0000
Ladyfish	0.0000	0.0055	0.8800	1.3000	4.3040	4.3040

Large Pelagic Fish	0.0002	0.0900	1.3400	1.2500	6.2000	4.5000
Large Sharks	0.0035	0.0028	0.0800	0.0800	1.0000	1.0000
Lobster / Shrimp	1.5000	1.3500	3.8925	2.3000	13.9200	10.0000
Lutjanidae	0.0092	0.0915	1.8000	1.5000	11.8000	7.0000
Mackerel	0.0012	0.1217	0.8000	1.2000	21.6150	7.6150
Manatees	0.0049	0.0049	0.1000	0.1000	0.0070	2.0000
Mangroves and Seagrasses	200.0000	25.0000	7.4860	5.0000		
Marlins	0.0102	0.0102	0.3800	0.3800	3.5000	3.5000
Meiobenthos	18.5000	18.5000	6.0000		22.0000	
Menehaden	0.9268	0.9268	2.1000	0.7000	6.3818	5.0000
Mullet	2.1000	0.0450	3.1000	2.1000	25.3210	8.0000
Mysticeti	0.0842	0.0842	0.7555	0.3000	8.1525	2.5000
Odontoceti	1.7741	0.0402	0.0880	0.2800	14.3278	1.7000
Other Billfish	0.0025	0.0030	0.6800	1.2000	7.4000	6.0000
Other Demersal Fish	1.1306	0.8000	1.0000	0.8000	6.0000	4.0000
Other Tuna	0.0084	0.0120	0.9000	0.9500	13.0000	8.0000
Pinfish	0.0001	0.0950	1.0190	2.0000	8.0000	9.0000
Plankton	25.0000	25.0000	160.0000	40.0000		
Pompano	0.0505	0.0305	1.0000	0.8000	8.0000	3.2000
Red Drum	0.1660	0.1660	2.1200	1.4000	11.6530	5.7000
Red Grouper	0.0450	0.0001	1.0333	1.2000	6.9476	6.9476
Red Snapper	0.0403	0.0403	0.7000	0.7000	5.2400	3.8000
Scaled Sardine	0.5000	0.5000	1.8000	2.0000	12.1060	12.1060
Sciaenidae	0.0012	0.0040	2.6000	1.5000	17.6000	8.0000
Sea Cucumbers	0.0000	0.1500	2.3500	2.0000	13.3500	12.0000
Sea Trout	0.0183	0.0183	2.7000	1.2000	4.0000	5.0000
Sea Turtles	0.0007	0.0092	0.2500	0.7500	3.5000	2.5000
Seabirds	0.0060	0.0008	0.8000	1.5000	71.7250	20.0000
Skates and Rays	0.0690	0.0690	0.8500	0.8500	6.1400	6.1400
Small Demersal Fish	0.0849	0.5400	1.0650	1.8000	7.7000	7.0000

Small Pelagic Fish	0.0556	2.1000	1.4620	1.5000	8.6608	7.8000
Small Reef Fish	0.2413	0.0980	1.9000	2.0000	8.6966	8.6966
Small Sharks	0.0352	0.0352	0.1250	0.3500	2.6095	2.2000
Snook	0.0000	0.0760	2.1300	1.4000	8.9103	7.9000
Soft Corals	1.0000	0.5000	0.0100	0.2800	2.0000	2.8000
Spanish Mackerel	0.0555	0.0555	0.8000	1.2000	21.6150	7.6150
Spanish Sardine	0.4500	0.0187	1.4620	1.4620	8.6608	8.6608
Swordfish	0.0027	0.0030	0.6800	0.7800	7.4000	5.0000
Vermilion Snapper	0.0450	0.0450	1.2000	1.2000	11.5000	8.0000
Yellowfin Tuna	0.0131	0.0162	0.7200	0.7200	5.2000	5.2000

Table 5: Final inputs and calculated parameters used in Ecopath model. Numbers in bold are those calculated by Ecopath.

Group name	Trophic level	Biomass (t/km^2) Finish	P/B Finish	Q/B Finish	EE	Respiration / assimilation	Net efficiency	Predation mort. rate yr^{-1}
Algae	1.0000	30.0000	27.5000		**0.0820**			0.4063688
Atlantic Bluefin	3.3975	0.0062	0.8900	8.0000	**0.4119**	0.8609	0.1390625	0.1254259
Atlantic Croaker	2.7043	0.3001	1.5000	10.0000	**0.6407**	0.8125	0.1875	0.120569
Barracuda	3.6648	0.0015	1.2000	4.0000	**0.1379**	0.6250	0.375	0.1654819
Bay Anchovy	2.0000	0.0098	4.0000	18.0000	**0.9756**	0.7222	0.2777778	3.258733
Benthic Feeding Sharks	3.3973	0.0650	0.4700	3.0000	**0.9376**	0.8042	0.1958333	0
Bivalves	2.0000	**0.0038**	2.4000	10.0000	0.2255	0.7000	0.3	390.1795
Black Drum	2.6408	0.0250	0.5780	3.6540	**0.0039**	0.8023	0.1977285	0.002239994
Blacktip Sharks	3.8386	0.0110	0.4000	2.0000	**0.9620**	0.7500	0.25	0
Catfish	2.6559	0.1000	0.9000	5.0000	**0.0895**	0.7750	0.225	0.08058795
Cehpalopods	3.2711	0.0900	1.9000	7.0000	**0.4646**	0.6607	0.3392857	5.327178
Crabs	2.0340	1.0000	2.3400	9.5000	**0.8445**	0.6921	0.3078947	2.411227
Deep Water Fish	3.1636	0.0420	1.3000	4.8000	**0.8820**	0.6615	0.3385417	1.146567
Detritus	1.0000	1.0000			**0.0083**		0	0.6406897
Eels	3.2672	0.0315	0.8000	3.1000	**0.6691**	0.6774	0.3225807	1.946867
Estuarine Fish	2.1325	0.0300	1.3000	6.1472	**0.5027**	0.7357	0.264347	0
Filter Feeding Sharks	2.0000	0.1017	0.7555	7.0000	**0.7333**	0.8651	0.1349107	0.1050747
Flatfish	3.1066	0.2120	0.4500	4.0000	**0.2335**	0.8594	0.140625	0.005788591
Gag Grouper	3.3235	0.0532	0.4580	3.0000	**0.0126**	0.8092	0.1908333	0.9434244
Gastropods	2.0000	0.5000	2.3500	13.3500	**0.8405**	0.7800	0.2200374	0.2249279
Greater Amberjack	3.7561	0.0298	0.9000	4.0000	**0.0268**	0.7187	0.28125	0.01541105
Groupers	3.3073	0.0922	0.4580	3.0000	**0.0327**	0.8092	0.1908333	1.563664
Horseshoe Crabs	2.2359	0.0015	1.6000	5.6000	**0.9773**	0.6429	0.3571429	0.4297181
Jacks	3.2682	0.1490	1.1640	7.7682	**0.3688**	0.8127	0.1873029	2.577809

Jellyfish	2.5090	0.0490	4.4000	15.0000	**0.5859**	0.6333	0.3666667	0.05259226
King Mackerel	3.0421	0.0159	2.3500	10.0000	**0.0223**	0.7063	0.29375	0.2184481
Ladyfish	3.0703	0.0055	1.3000	4.3040	**0.1680**	0.6224	0.3775558	0.1172793
Large Pelagic Fish	3.3573	0.0900	1.2500	4.5000	**0.0938**	0.6528	0.3472222	0.01
Large Sharks	4.0643	0.0028	0.0800	1.0000	**0.1250**	0.9000	0.1	5.582797
Lobster / Shrimp	2.3586	1.3500	2.3000	10.0000	**0.4949**	0.7125	0.2875	1.211602
Lutjanidae	3.2649	0.0915	1.5000	7.0000	**0.0792**	0.7321	0.2678571	0.7563751
Mackerel	2.2940	0.1217	1.2000	7.6150	**0.2118**	0.8030	0.1969804	0.005710789
Manatees	2.0000	0.0049	0.1000	2.0000	**0.0571**	0.9375	0.0625	0.03501028
Mangroves and Seagrasses	1.0000	25.0000	5.0000		**0.0070**			0
Marlins	3.8091	0.0102	0.3800	3.5000	**0.9930**	0.8643	0.1357143	0.02819822
Meiobenthos	1.0000	18.5000					0	1.604591
Menehaden	2.0000	0.9268	0.7000	5.0000	**0.0403**	0.8250	0.175	0.002327277
Mullet	2.0000	0.0450	2.1000	8.0000	**0.7641**	0.6719	0.328125	0.009760227
Mysticeti	2.0000	0.0842	0.3000	2.5000	**0.2453**	0.8500	0.15	0.03733333
Odontoceti	3.4241	0.0402	0.2800	1.7000	**0.0349**	0.7941	0.2058824	0.5378066
Other Billfish	3.6178	0.0030	1.2000	6.0000	**0.0307**	0.7500	0.25	0.8511763
Other Demersal Fish	2.8467	0.8000	0.8000	4.0000	**0.6723**	0.7500	0.25	0.6935146
Other Tuna	3.4004	0.0120	0.9500	8.0000	**0.8960**	0.8516	0.1484375	1.414169
Pinfish	2.0000	0.0950	2.0000	9.0000	**0.3468**	0.7222	0.2777778	0.6415389
Plankton	1.0000	25.0000	40.0000		**0.9800**			0.08666556
Pompano	3.3011	0.0305	0.8000	3.2000	**0.1458**	0.6875	0.3125	0.84
Red Drum	3.0823	0.1660	1.4000	5.7000	**0.9257**	0.6930	0.3070176	0.1101037
Red Grouper	3.2250	**0.0001**	1.2000	6.9476	0.7000	0.7841	0.2159027	0.08231755
Red Snapper	3.2497	0.0403	0.7000	3.8000	**0.1573**	0.7697	0.2302632	1.344584
Scaled Sardine	2.0000	0.5000	2.0000	12.1060	**0.0412**	0.7935	0.2065092	1.740416
Sciaenidae	2.5959	0.0040	1.5000	8.0000	**0.8920**	0.7656	0.234375	0.7692049
Sea Cucumbers	2.0000	0.1500	2.0000	12.0000	**0.8702**	0.7917	0.2083333	0.7492594
Sea Trout	3.1657	0.0183	1.2000	5.0000	**0.6410**	0.7000	0.3	0.6

Sea Turtles	3.0818	0.0092	0.7500	2.5000	**0.9861**	0.6250	0.375	0.09051639
Seabirds	3.0986	**0.0008**	1.5000	20.0000	0.4000	0.9063	0.09375	1.72732
Skates and Rays	3.1052	0.0690	0.8500	6.1400	**0.7226**	0.8270	0.1730456	1.545694
Small Demersal Fish	2.0870	0.5400	1.8000	7.0000	**0.9596**	0.6786	0.3214286	3.734376
Small Pelagic Fish	2.1111	2.1000	1.5000	7.8000	**0.4987**	0.7596	0.2403846	0.08684375
Small Reef Fish	2.5855	0.0980	2.0000	8.6966	**0.9065**	0.7125	0.2874693	0.2527686
Small Sharks	3.3453	0.0352	0.3500	2.2000	**0.2481**	0.8011	0.1988636	0.2496171
Snook	2.8451	0.0760	1.4000	7.9000	**0.1805**	0.7785	0.221519	0.6249315
Soft Corals	2.0000	0.5000	0.2800	2.8000	**0.8915**	0.8750	0.125	3.529945
Spanish Mackerel	3.1258	0.0555	1.2000	7.6150	**0.6050**	0.8030	0.1969804	0.3967595
Spanish Sardine	2.0000	0.0187	1.4620	8.6608	**0.2905**	0.7890	0.211009	0.05628129
Swordfish	3.7623	0.0030	0.7800	5.0000	**0.6616**	0.8050	0.195	0.0460148
Vermilion Snapper	2.9963	0.0450	1.2000	8.0000	**0.0468**	0.8125	0.1875	
Yellowfin Tuna	3.3980	0.0162	0.7200	5.2000	**0.9984**	0.8269	0.1730769	

Table 6: Overall system statistic calculated for Gulf of Mexico modeled ecosystem. No unites are provided for indices and ratios.

Parameter	Value	Units
Sum of all consumption	84.30025	t/km²/year
Sum of all exports	1765.579	t/km²/year
Sum of all respiratory flows	50.73995	t/km²/year
Sum of all flows into detritus	925.5998	t/km²/year
Total system throughput	2826.219	t/km²/year
Sum of all production	1966.701	t/km²/year
Mean trophic level of the catch		
Gross efficiency (catch/net p.p.)		
Calculated total net primary production	1950	t/km²/year
Total primary production/total respiration	38.43126	
Net system production	1899.26	t/km²/year
Total primary production/total biomass	21.41003	
Total biomass/total throughput	0.03222638	t/km²/year
Total biomass (excluding detritus)	91.07881	t/km²
Total catch		t/km²/year
Connectance Index	0.1437026	
System Omnivory Index	0.2010427	
Total market value	0	1
Total shadow value	0	1
Total value	0	1
Total fixed cost	0	1
Total variable cost	0	1
Total cost	0	1
Profit	0	1
Ecopath pedigree	0	
Measure of fit, t*	0	
Shannon diversity index	1.695917	

Table 7: Trophic level flows from primary producers and detritus (t/km^2) and transfer efficiencies (%) in the Northern Gulf of Mexico.

Trophic Level	Flow				
	Consumption by Predators	Export	Flow to Detritus	Respirations	Throughput
Trophic level flows from primary producers					
IX	0	0	0	0	0
VIII	0.0000001	0.0000001	0.0000019	0.0000036	0.0000058
VII	0.000014	0.000001	0.0000895	0.0001791	0.0002837
VI	0.0003073	-0.000006	0.0016891	0.003382	0.0053721
V	0.0053872	-0.001298	0.0242	0.0462742	0.0745631
IV	0.0745608	-0.010096	0.313997	0.6363843	1.0148452
III	1.0141632	-0.680249	2.20718	4.454266	6.9953603
II	6.9948797	-4.062047	14.520905	30.964437	48.418182
I	48.420543	857.04956	901.5083	0	1806.9783
Sum	56.509857	852.29583	918.57635	36.104927	1863.487
Trophic level flows from detritus					
IX	0	0	0	0	0
VIII	0	0.0000001	0.0000009	0.0000018	0.0000029
VII	0.0000095	0.0000001	0.0000575	0.0001145	0.0001817
VI	0.0001946	-0.000002	0.0010865	0.0021736	0.0034519
V	0.0034571	-0.000648	0.0163566	0.0316865	0.050852
IV	0.0508562	-0.010394	0.2067213	0.4094042	0.6565872
III	0.65627	-0.378083	1.5074666	3.1224291	4.9080839
II	4.9042658	-4.210476	5.2918801	11.06921	17.054878
I	17.059473	917.88287	0	0	934.94238
Sum	22.674526	913.28326	7.02357	14.63502	957.61639

Source	Trophic Level						
	II	III	IV	V	VI	VII	VIII
Producer	14.446803	14.497655	7.3470167	7.2250425	5.7205438		
Detritus	28.755795	13.371206	7.7455386	6.798499	5.639353		
All Flows	18.174108	14.033192	7.5035676	7.0520922	5.688782	5.057121	2.104704
Proportion of total flow originating from detritus: 0.34							
Transfer efficiencies (calculated as geometric mean for TL II-IV)							
From primary producers: 11.54498905%							
From detritus: 14.38740790%							
Total: 12.41535470%							

Figure 3: Flow chart diagram showing tropic interactions within the Gulf of Mexico based on dietary connections in Ecopath model.

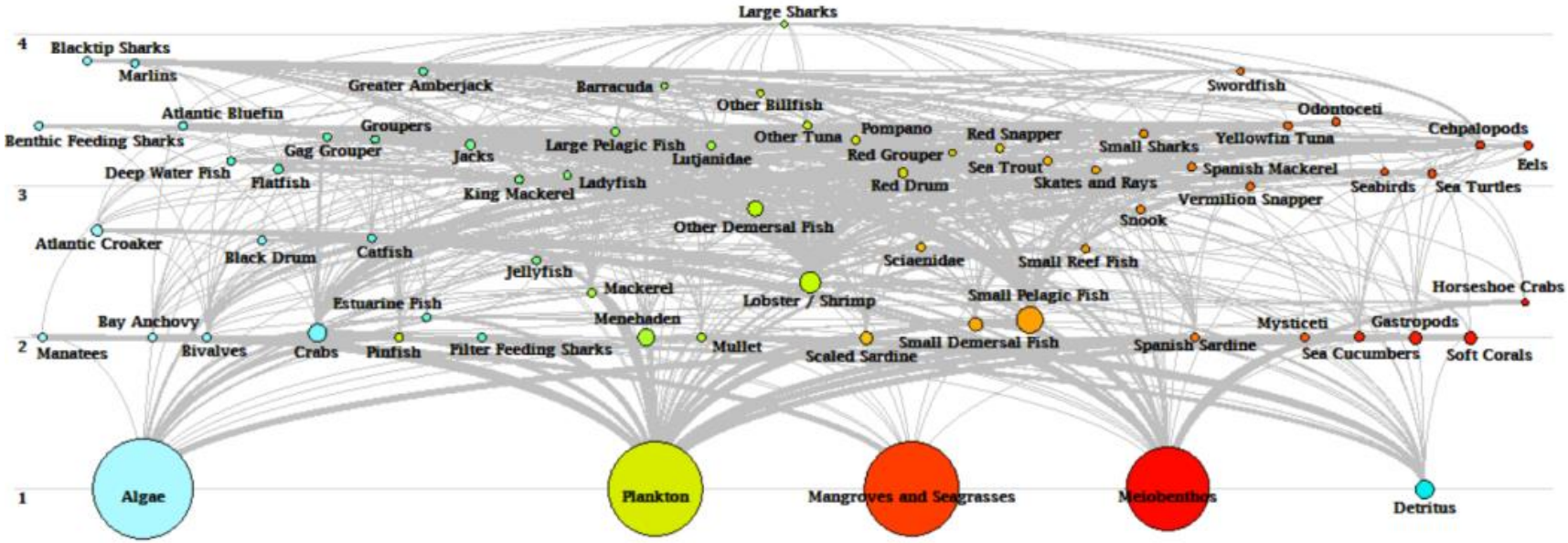
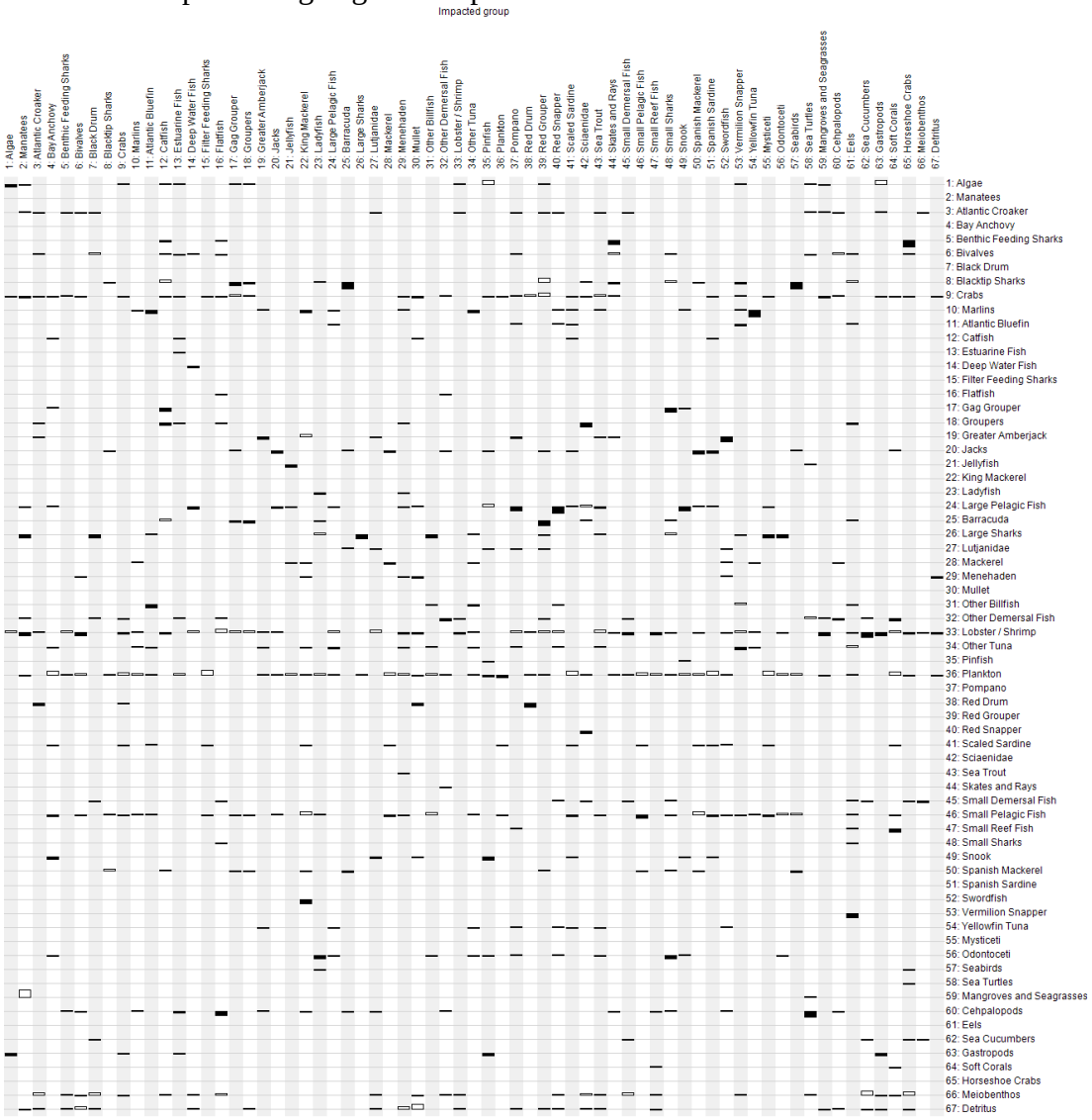


Figure 4: Mixed trophic impacts plot where upward bars represent positive impacts and downwards representing negative impacts.



CHAPTER 3

A FRAMEWORK FOR A TRI-NATIONAL BIOLOGICAL CONSERVATION AGREEMENT IN THE GULF OF MEXICO

Abstract

International agreements have been used to focus on areas of both marine and terrestrial conservation concern. Currently, The Convention for the Protection and Development of the Marine Environment in the Wider Caribbean Region, the Cartagena Convention (CC), is the only multilateral environmental agreement in effect in the Gulf of Mexico Large Marine Ecosystem (GoM-LME). The GoM-LME provides diverse habitats to maintain the high diversity of species including endemic and endangered species and provides natural resources for the United States, Cuba, and Mexico. This paper investigates the legal frameworks currently recognized in the Gulf of Mexico to build a proposed tri-national framework. We investigated the current multilateral agreements governing conservation practices in the GoM-LME as well as the legal context for decisions made at the national level. In addition, gaps in areas such as pollution, oil spill response, and species conservation were identified allowing for the development of a proposed tri-national agreement governing biological conservation in the region. The creation of a tri-national agreement focusing on conservation efforts in the Gulf of Mexico between these three countries would allow for specific regional conservation concerns to be addressed.

1 | Introduction

The Gulf of Mexico Gulf of Mexico Large Marine Ecosystem is a semi-enclosed oceanic basin of about 615,000 mi^2 (1.6 million km^2) located east of Mexico, northeast of

Cuba and south of the United States (Sevilla et al., 2018). The ecosystem, shared by Mexico, Cuba and the United States, has enriched ecosystem diversity and increased productivity due to the provided North American watershed. This large marine ecosystem (LME) provides an important habitat for many living marine resources and plays a large socioeconomic role for these countries (Zaldívar-Jiméneza et al., 2017; Jackson et al., 2020). As with many other areas, the Gulf of Mexico (hereafter "GoM") is currently facing the ongoing loss of marine biodiversity due to regional and global factors such as pollution, fishing practices, coastal development, and climate change (Balvanera et al., 2006; Gamfeldt et al., 2008; Gil-Agudelo et al., 2020, Halpern et al., 2008; Hooper et al., 2012; Strongin et al., 2020). Connected to the Caribbean Sea through the Yucatan channel, the LME is geophysically linked and part of the Wider Caribbean Region (WCR), a geographical construct defined by Article 2 of the Cartagena Convention (Cartagena). Many species in the GoM are considered transboundary and connected to populations occurring in the Greater Caribbean Sea, making it important to address conservation issues at a regional and international level (Nash & McLaughlin, 2012).

Regional conservation and management efforts of the marine environment have historically included a variety of measures aimed at the wider geographical location including the GoM and the Wider Caribbean Sea. One example is the Regional Seas Programme (RSP) for the Wider Caribbean Region, known as the Cartagena Convention, while others include the regional fisheries bodies which straddle the waters of the region (e.g. OLDEPESCA). The use of the RSP methodology has seen mixed results, and is often plagued by limited fiscal and physical resources, along with the political will to implement management efforts. For example, in WCR, the reluctance of states to endorse

and ratify the Protocol on Land Based Pollution led to lost time and resources, which reduced the effectiveness of the management of fisheries, protected species, and areas of conservation interest. One of the responses to this inertia was to embrace the LME methodology to address the challenges of declining fish stocks. This was coupled with the recognition that there needed to be a supportive vehicle apart from the use of the RSPs functioning in the region (Fanning et al., 2009).

In the Greater Caribbean, biological conservation efforts are principally governed under the Cartagena Convention and its three protocols. Other agreements of note are the Western Hemisphere Convention and the Inter-American Convention for the Protection and Conservation of Sea Turtles. Ratified in 1981, Cartagena established the Caribbean Environment Programme (CEP), an agreement between twenty-four Latin American and Caribbean countries in addition to the United States, the United Kingdom and France. The purpose of Cartagena was to establish cooperation among stakeholders of the Wider Caribbean Sea and promote the protection and development of the marine environment. The key framework of Cartagena relies on regional cooperation to identify priority issues, negotiate, and develop regional environmental agreements, and consolidate cooperation between governments. The agreement also allows local and regional governments to control environmental management activities while working toward regional conservation standards. One of the goals of Cartagena is to coordinate assessment activities and analyze the effectiveness of regional policies (Desmond & Powers, 2017).

Currently, Cartagena is the only multilateral environmental agreement (MEA) which focuses specifically, directly, and holistically on the main aspects of marine environment and conservation concerns in the Wider Caribbean Region. Cartagena is the

only international law document applicable to the GoM, which has been ratified by the United States, Mexico, and Cuba (Desmond & Powers, 2017). However, differences in biodiversity, ecosystems, and socioeconomics, in addition to varying systems of governance between the United States, Mexico, and Cuba, have historically made the creation of bi- and tri- lateral agreements difficult (Baur et al., 2018). The aim of this study is (1) the identification of gaps in the currently existing international and domestic conservation policies between and within these countries in the Gulf, and (2) to outline best practices for developing a tri-national agreement governing conservation efforts between the three GoM states.

2 | Materials and Methods

We conducted a review of scientific literature, extracted from Internet databases, as well as a review of the current environmental instruments and official documents related to the Cartagena Convention, including those adopted by the United States, Mexico, and Cuba. In addition, we requested information through feedback provided from environmental managers of each country based on their perspectives on the environmental policies in place for each country and also on their opinion as to how an international agreement between these countries might be structured in accordance with the environmental policies currently in place for each country.

2.1 | The Framework and Protocols of the Cartagena Convention

Recognition of the importance of regional approaches to address both oceanic and land-based pollution led to the creation of several regional frameworks under the United Nations Regional Seas Program (RSP), including the Cartagena Convention (Anon, 1984; Bundschuh, 1984). The Cartagena Convention was developed by the United Nations

Environmental Programme as one of the specific actions coming out of the United Nations Conference on Environment and Development in 1972 (Sheehy, 2004). Despite several difficulties, the Convention, along with the Barcelona Convention dealing with the Mediterranean Sea, is viewed as one of the more developed RSPs. Cartagena was intended to address, among other areas of marine management, conservation, and the aspects of pollution covered under the 1973/1976 International Convention for the Prevention of Pollution from Ships (MARPOL) (Bliss-Guest, 1981). This response was necessary in the Wider Caribbean Region as a result of the increase in shipping, tourism, and to a lesser extent oil production, which highlighted the need for a more specific framework to address regional concerns.

Cartagena was established as a framework instrument, which would be articulated by means of protocols on the general obligations and thematic areas identified by the Parties. There is also the scope for the adoption of new protocols and amendment of existing protocols to facilitate the Convention's effective functioning in relation to changing and emerging threats. Cartagena's three protocols were created during a 25 year period and address three thematic areas of conservation concern. Each of these protocols can be considered a stand-alone agreement within the larger framework of the Cartagena Convention, and with the exception of the Oil Spill Protocol, must be adopted and ratified by signatory countries according to Article 17 of the Cartagena Convention. Parties to Cartagena, must also adopt the Protocol Concerning Co-operation in Combating Oil Spills in the Wider Caribbean Region (Oil Spills) at the same time. The Oil Spills Protocol, like Cartagena was adopted in 1983 and became effective in October 1986. Subsequently, the Protocol Concerning Specially Protected Areas and Wildlife (SPAW)

was adopted on 18 January, 1990 and became effective in June 2000. Lastly, the Protocol Concerning Pollution from Land-Based Sources and Activities was adopted in October 1999 and became effective in August 2010. To date, only 12 contracting parties, including the United States, have ratified all three of Cartagena's Protocols (Table 8).

3 | Results

3.1 | The Protocol Concerning Co-operation and Development in Combating Oil Spills in the Wider Caribbean Region

Cartagena's oldest and arguably least developed Protocol, the Co-operation and Development in Combating Oil Spills in the Wider Caribbean Region (the Oil Spills Protocol) (Boxer, 1982) was entered into force at the same time as the Convention in 1986. Unlike Cartagena's other technical agreements, the Oil Spill Protocol is mandatory for signatories of the Convention, and underscores the concerns of marine pollution to regional states. The Protocol outlines five areas relating to oil exploration and oil spill management within the region which include 1. the acknowledgement that oil exploration and associated activities pose a risk to the region; 2. that islands are particularly vulnerable to the effects of an oil spill, should an oil spill occur; 3. nations should be prompt in their mitigation and clean-up activities; 4. the recognition that preparation and co-operation are necessary when responding to a spill, and lastly, 5. to prevent and combat pollution from oil spills which may further degrade the marine environment. An Annex to this protocol allows it to be equally applied to spills of all hazardous substances within the WCR.

In January 1984, the Oil Spills Protocol was presented and read to the Foreign Relations Committee of the United States Senate, and by unanimous vote, the Protocol

was favorably reported to the Senate for consent and ratification. The Protocol was viewed as a way to better outline obligations concerning marine based pollution and "an important step in creating, in the region, marine pollution standards which are generally higher, more uniform, consistent in character, and closer to our own than presently exist" (Regan, 1984). In Mexico, the Protocol was recognized on April 15, 1981 and was published in the Federal Official Gazette for the Presidential Agreement. This allowed the Council chaired by the General Commander of the Marine Secretary to create the National Contingency Plan to Combat and Control Oil Spills and other Harmful Substances into the Sea. On February 8, 1999, an amendment was published to prevent harm to the marine ecosystem from pollution by establishing responsibilities and integrating response protocols. On May 20, 2013, the Federal Official Gazette published the Presidential National Development Plan 2013-2018, which outlined the objectives, strategies and indicators governing Mexico, and highlighted ways to combat and control pollution issues in the marine environment while proposing technical solutions though coordination of activities. On October 24, 2016 the Federal Official Gazette published Agreement Number 249, creating the abbreviated version of the National Plan of Contingency for Oil Spills and other Harmful Substances to Mexican Marine Zones (DOF, 2016). Cuba ratified the Oil Spill Protocol on September 15, 1988, at the same time that the country ratified the Cartagena Convention.

3.2 | The Protocol Concerning Specially Protected Areas and Wildlife

The Protocol Concerning Specially Protected Areas and Wildlife to the Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region (SPAW), was the second of Cartagena's Protocols to be adopted.

SPAW is anchored to Article 10 of Cartagena, which provides that countries protect and preserve rare or fragile ecosystems, while giving special attention to the habitats of threatened or endangered species (Barker, 2002). Freestone (1990) posits that SPAW is arguably the most comprehensive regional wildlife protection treaty in the world and is certainly the most comprehensive of its kind. SPAW began its life as one of two resolutions during the Cartagena Conference of Plenipotentiaries in 1983 and was developed over two successive meeting in 1988 and 1989. The original working draft was based on RSP Wildlife Protocols for the Mediterranean Sea and East Africa. However, the need for a comprehensive framework for wildlife management comprising lists of protected areas of regional importance and protected species was agreed upon, and an appropriate governing framework was drafted (UNEP, 1995). The five areas outlined in this Protocol include 1. the acknowledgement of Article 10 of the Convention requiring the creation of protected areas; 2. that the integrity of the marine and coastal environment is threatened by poor development; 3. recognition that sustainable development is essential to the protection and maintenance of the environment; 4. recognition of the ecological, economic, aesthetic, scientific, and cultural, value of rare of fragile ecosystems, and lastly, 5. to appreciate the interconnectedness and impact of threats to the ecosystems of the region (Desmond & Powers, 2017; Barker, 2002).

The SPAW Protocol is considered a revolutionary agreement as it incorporates key elements of leading wildlife treaties, notably the Convention on the International Trade in Endangered Species (CITES), The Ramsar Convention on Wetlands of International Importance Especially as Waterfowl Habitat (Ramsar) and the Convention on the Conservation of Migratory Species (CMS), as well as the Convention on

Biological Diversity (CBD), which it predated. SPAW was adopted before the creation of the United Nations Convention on Environment and Development (UNCED) (UNEP, 1995) and much of the information found in the SPAW protocol, helped to inform the United Nations Convention on Biological Diversity which received much wider acceptance (Vanzella-Khouri, 1998; Lancaster, 2012). Using various mechanisms from these instruments, the SPAW protocol focuses on the need for regulatory measures and the creation of protected areas throughout the Wider Caribbean. As part of these regulatory measures, Annex I, II, and III of the Protocol define the protected species of marine and coastal flora and fauna as defined under Article 11(1) (a), (b), and (c) (Desmond & Powers, 2017; Barker, 2002). An important feature is the ecosystem approach underpinning the link between the SPAW and Cartagena's third Protocol through the categorization of Class I waters (Anon, 2002). Defined in the LBS Protocol as areas that provides habitat for species protected under SPAW, as well as protected areas listed under SPAW (LBS Protocol, Annex III (A) (2)), it encompasses coastal, land-based and marine threats to the environment.

The SPAW Protocol was signed by the United States in 1990, with President Bush indicating his support for the protocol, but it was not submitted to the Senate until 1993, and after further negotiation was ratified in 2000. The United States' involvement in the negotiations meant that many of the provisions of the Protocol reflected existing U.S. environmental laws. These included, the Marine Protection, Research, and Sanctuaries Act, the Coastal Zone Management Act, the Wilderness Act, the Endangered Species Act, the Marine Mammal Protection Act, and the Migratory Bird Treaty Act (Wold, 2003). However, after initial review in 1993, three reservations were made. The

first was that the United States not be bound by the provisions on Article 11(1) due to current US law allowing for the limited take of flora and fauna as outlined in the Marine Mammal Protection Act and the Endangered Species Act. The second reservation involved environmental impact assessment requirements as outlined in Article 13. This reservation was due to conflicting federal laws and differences in obligations with Article 12 of the Cartagena Convention on Oil Spills. The last reservation recognized differences in species needing protection according to the Annexes of the SPAW Protocol and those species currently recognized by the Endangered Species Act (Vanzella-Khouri, 1998; Wold, 2003).

In Mexico, the environmental authority, represented by the Secretariat for the Environment and Natural Resources (SEMARNAT) and the Agency for the Knowledge of Biodiversity (CONABIO), consider the SPAW Protocol as incompatible with the management of protected areas and species in Mexico for three reasons. First, Annex I of the Protocol includes species which are permitted for use by the indigenous people of Mexico. Second, Annex I of the SPAW Protocol contains species which are legally traded in Mexico and thirdly, Annex II of the SPAW Protocol contains species, such as crocodiles (*Crocodylus moreletti, C. acutus*) which in Mexico are legally approved to be sustainably traded (technical opinion by CONABIO).

The Cuban government signed the SPAW Protocol on January 18, 1990 and ratified it on August 4, 1998. After ratification, Cuba sought to enter a reservation to protect the hawksbill sea turtle (Eretmochelys imbricata), due to fishing pressure in Cuban waters (Wold, 2003); in 2008 its capture was completely prohibited (Campbell, 2014; Cham, 2017). In January 2002, Cuba participated in an ad hoc working group to

review the criteria needed to include species in the annexes of specially protected flora and fauna. Cuban experts held a meeting in December 2011 to review the species listed in the annexes of the SPAW protocol resulting in a proposal to add several new species in addition to the elimination of mainly endemic species due to the provisions listed in selection criteria. A review of several other species was proposed due to nomenclature or uncertainty in species' distribution, or a change to their risk category. The report of this meeting was presented to the Fifth Meeting of the Scientific and Technical Advisory Committee (STAC) to the SPAW Protocol.

3.3 | The Protocol Concerning Pollution from Land-Based Sources and Activities

The third of Cartagena's Protocols to be adopted was the Protocol Concerning Pollution from Land-Based Sources (LBS) and Activities to the Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region (LBS). Key concepts of this protocol are linked to soft law documents such as the Rio Declaration, Chapter 17 of Agenda 21, the Programme of Action for the Small Islands and Developing States and the Global Programme of Action for the Protection of the Marine Environment from Land-based Activities, and the Convention on the Law of the Sea (Anon, 2007). It is noteworthy, that despite its tortuous journey, the LBS has managed to achieve codification at a regional level. The main focus of the LBS Protocol was to outline the importance of co-operation at the regional level when addressing the threat posed by land-based pollution to marine and coastal resources and human health. The regional social and economic differences were important to the creation of a framework based on sustainable development. Pollutants of concern are defined within the LBS' four Annexes which in addition outline the plans for prevention, reduction, and

control of agricultural non-point source pollution respectively and the factors to be used in determining effluent and emission source controls and management factors.

In 2007, President George W. Bush and Condoleezza Rice sent a letter of consent for approval of the LBS Protocol. The Administration recognized that the Protocol addressed the "most serious sources of marine pollution" as originating on land and from activities such as waste water and agricultural runoff. The United States already had specific standards through statutory and regulatory authority for treating wastewater outflows and saw Annex III of the Protocol as strengthening the SPAW Protocol, by raising standards for other countries throughout the region therefore protecting commercial fisheries, local economies, and biodiversity (Anon, 2008; CAR, 2010).

Mexico ratified the LBS Protocol in 1990 as part of the national strategy to protect and preserve the richness and biodiversity of marine resources. The various commitments included in the ratification of this Protocol, together with those included in other signed agreements, protocols and instruments of international regulation and standards (e.g. UNCLOS, MARPOL , London Dumping Convention and Protocol) were used in the creation of the "Política Nacional de Mares y (PNMC, National Policy of Seas and Coasts of Mexico). The PNMC, first published in the Mexican Federal Official Gazette in November of 2018, has become the guiding policy for the comprehensive management of Mexican coasts and seas, including the prevention and control of marine pollution from land-based sources and activities (Aguilar Perera, Perch, and Pérez pers comm 2020).

Cuba has not ratified the Protocol, but the Cuban Transportation Research and Environmental Management Center (CIMAB) serves as the Regional Activity Center

(RAC) of the LBS Protocol. In this sense, CIMAB works to improve the environmental quality of the bays and coastal areas of the Caribbean region, through the evaluation and control of the dumping of pollutants from land-based sources. CIMAB promotes scientific-technical cooperation between specialized UN agencies, intergovernmental, governmental and non-governmental organizations to guarantee compliance with the LBS Protocol. In addition, it provides scientific and technical assistance, trainings, courses, seminars and workshops to governments and institutions in the region (González, Perrera,and Rojas pers comm 2020).

4 | Discussion

4.1 | United Nations Environmental Agreements and the Cartagena Convention

Cartagena as a regional marine conservation agreement, combines principles of international law embedded in established multilateral environmental agreements (MEAs), as well as incorporates elements indigenous to the region. As the constitution of the sea, the 1983 UNCLOS underpins many of the features of the agreement, and is also augmented by other key instruments such as the 1973/78 MARPOL, the CBD, Ramsar, CITES and the CMS. In addition, because the GoM and the Caribbean Sea are the habitat and in the migratory path of at least 32 species of marine mammals (Matthews, 1993), an Action Plan for the Conservation of Marine Mammals (MMAP) was elaborated in 2008. As a result, there is a close nexus between the SPAW Protocol and the International Convention on the Regulation of Whaling (ICRW). As outlined in the sections below, these linkages create many synergies between the international instruments and Cartagena, and will need to be given careful consideration in the development of a model framework for the GoM.

Since 2004 there has been increased interest in the conservation of transboundary biodiversity in areas beyond national jurisdiction (ABNJ). This interest is linked to a better understanding of the impacts of threats such as overfishing, pollution, and climate change (Ma et al., 2016). Many of the agreements previously discussed address these areas of concern but do not apply to international waters. The need for newer guidelines has been recognized with the introduction of new technologies and a changing economic environment (Stojanovic & Farmer, 2013), and after a protracted process, member states of UNCLOS may be close to adopting a new legally binding instrument to conduct environmental impact assessments in consonance with the United Nations General Assembly Resolution 69/292 of 6 July 2015. This legislation emphasizes the importance of the previous agreements while focusing on the need to better understand anthropogenic impacts on the marine environment moving forward (Druel & Gjerde, 2014; Naser, 2015).

4.2 | The Ramsar Convention

Originally signed in 1971, the Ramsar Convention was the first international agreement focusing on the conservation of natural resources at a global scale (Guarderas et al., 2008). The importance of this Ramsar to the later development of the Cartagena Convention is the existence of extensive mangrove, sea-grass beds, estuarine and other wetlands in the Wider Caribbean Region which aligns with the Convention's focus on the importance of wetlands to biodiversity conservation. Additionally, since most of the marine protected areas in the region are within twelve nautical miles from shore (Zaldívar-Jiménez et al., 2017), wetland and coastal systems are of critical importance as evidenced by the SPAW, and the Class I Waters designation under the LBS Protocol. As

with the WCR, the influence of Ramsar is also critical to the GoM, as the area has a very high diversity of marine habitats that includes tropical and temperate ecotones, estuaries, mangrove wetlands, and shallow inshore waters (Jóhannsdóttir, 2010).

Ramsar was initially begun by IUCN as ProjectMAR in 1962, wetland conservation efforts were eventually proposed to the United Nations Educational, Scientific and Cultural Organization (UNESCO). As with other IUCN designations, the Ramsar Convention outlined criteria necessary for designating wetlands as being of international importance. These criteria were considered during development of the SPAW Protocol and eventually led to a Memorandum of Cooperation being signed between the Ramsar and Cartagena Conventions in 2000 which outlined the joint development of conservation programs for wetlands of interest in the wider Caribbean region (Wijnstekers, 2011).

4.3 | CITES

Similar to the development of Ramsar in 1960, IUCN requested that governments restrict the import of animals in accordance with the export regulations of the countries of origin (Birnie & Redgwell, 2009). In 1973 the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) was signed and recognized the global importance of species conservation. The influence of CITES on the SPAW Protocol is evident, specifically in the adaptation of CITES' approach to listing species in Appendices to the system of Annexes used in SPAW. The conservation of species within the Wider Caribbean Region, especially those listed on the IUCN Red List as threatened, is covered under the SPAW Protocol but many WCR nations are also signatories of CITES. Recent collaborations between CITES and the Cartagena Convention have

focused on sea-turtle conservation efforts (for example, CITES Decisions 12.44-12.46, 14.86.14.87, and 15.84). These efforts at conserving marine-turtles are supplemented in the WCR by the Inter-American Convention on the Conservation of Turtles (IAC), to which many members of Cartagena, including Mexico and the USA are members. Apart from SPAW, the IAC is perhaps the most notable regional agreement which features in the marine conservation framework, as the Western Hemisphere Convention is considered a "sleeping treaty" (Blomquist, 2002). It is also important to note that Cuba's argument with respect to the relationship between CITES and SPAW in relation to the hawksbill turtle, which was absolutely protected under CITES' Appendix I and SPAW's Annex II, and its attempt to enter a reservation to SPAW, compelled the CITES Secretariat to commission a legal opinion (Campbell, 2014).

4.4 | The Convention on Biological Diversity

Another international agreement built into or helping to govern the wider framework of the Cartagena Convention is the internationally renowned Convention on Biological Diversity (CBD). The CBD came into force in 1992 with the primary objectives of biodiversity protection, which was influenced in part by the discussions culminating in the SPAW Protocol (Barker, 2002). It may be argued that because of the relationship between the SPAW Protocol and the CBD, many countries did not see the need to ratify both. An example is the United States, which was a non-signatory to CBD due to a lack of initiative in the US Congress during the end of the Clinton presidency (51st U.S. Congress; Schweizer, 1999). However, because SPAW's scope with respect to marine management and conservation is broader than that of the CBD, and the need to focus the broad objectives of the CBD on regional priorities, this may be viewed as an ill-

conceived notion. The benefit derived under both instruments however, needs to be balanced with the fact that many members of Cartagena have financial and technical limitations which impact their active participation in a broad spectrum of agreements. The need for cooperation between Cartagena and other MEAs, such as the CBD, CITES, and Ramsar, was highlighted by the failure of many WCR nations to ratify SPAW (Barker, 2002; Lancaster, 2012). Recently, there have been mechanisms to promote these synergies, including the Aichi Biodiversity Targets, Seoul Outcomes and Seoul Outcomes Plus 2, which will also be instructive to the development of a model framework for the Gulf of Mexico.

The increased use of GMOs and their impact on biodiversity was recognized by The Cartagena Protocol on Biosafety. This Protocol is not linked to the Cartagena Convention but is one of the CBD's protocols created to recognize the impact of GMOs on ecological systems. While Cuba and Mexico have ratified this agreement, the United States, along with Canada, Australia, Argentina, Chile, and Uruguay, blocked consensus in 1999 due to concerns over the economic losses associated with the regulations imposed on certain GMO crops (CMS Sharks, 2016).

4.5 | The Convention on Migratory Species

Another international agreement whose principles are incorporated into SPAW is the Convention on Migratory Species (CMS). Unlike Ramsar, CITES and the CBD, the CMS does not enjoy as wide membership in the WCR. For example, of the GoM states, only Cuba is a party to CMS. However, as an agreement, the CMS adopts an approach of elaborating agreements, memorandums of understanding (MoUs), or species-specific initiatives which offer protection at the level of range states. As such, it is an added layer

of biodiversity protection to CBD, CITES and the SPAW Protocol. In 2016, under the framework of CMS, the CEP along with the UN Environmental Programme (UNEP) entered into a MoU with the CMS Secretariat on the Conservation of Migratory Sharks, the first international non-binding instrument for the conservation of these species. The objectives of the MoU will be rolled out mainly through the SPAW Protocol and include, collaborating with regional fisheries bodies in the Wider Caribbean. These synergies will hinge on management plans and overlaps between existing and proposed MPAs listed under the SPAW Protocol and the distribution/occurrence for potential conservation and management of sharks and ray species listed under Annex II and Annex III of the SPAW Protocol (Cruz & McLaughlin, 2008).

4.6 | Current Role of Conservation in the United States, Mexico, and Cuba Policy

The three nations of the Gulf of Mexico LME currently have both regional and national conservation policies in place; there are also currently 59 bilateral and multilateral regional agreements governing various environmental policies and practices (Table 2). The Earth Summit of 1992 recognized that governance of ocean systems would be best applied and most effective when viewed in the context of Large Marine Ecosystems (LME) (Cruz & McLaughlin, 2008). Conservation efforts in the three countries has begun to reflect this approach, but historical conservation practices, socio-economic differences, and current governmental regimes have shaped the current conservation priorities, practices, and values of the United States, Mexico, and Cuba.

4.6.1 | Conservation in the United States

Throughout much of the coastal United States, management is based on local and regional policies. The Marine Resources and Engineering Development Act of 1966

attempted to unify the approach to coastal management. As part of the Act, a commission was developed to review current marine management policies; the resulting report, Our Nation and the Sea: A Plan for National Action, led to many of the management structures seen today, including the National Oceanographic and Atmospheric Administration (NOAA) and the Magnuson-Stevens Fisheries Management Act of 1976 (94th Committee on Commerce, 1976). Prior to 1976, foreign fishing took as much as 6.4 billion pounds of catch within 200 miles of the US coast (Dell'Apa et al., 2012). The newly established Exclusive Economic Zone (EEZ) allowed the United States to oversee the management of all fishes, except those species which are highly migratory, within its waters (Pontecorvo, 1977). Eight Regional Fisheries Management Councils were established with each council responsible for the development of a fisheries management plan that must meet national conservation and management standards (Cloutier, 1996; Hoss et al., 1999; Kaile, 1992).

The Fisherman's Protective Act of 1967, the Marine Mammal Protection Act of 1972, The Endangered Species Act of 1973 and ratification of CITES in 1975, all helped to develop the framework for management of coastal and marine species in the United States (Czech & Drausman, 2001; Blomquist, 1991). During the beginning of George H. W. Bush's presidency, the EPA was asked to identify strategies and improve risk assessments for areas of environmental concern (Ceballos & García, 2013). The final report identified four main areas on which to focus future environmental policy: habitat alteration and destruction, species extinction and loss of biodiversity, ozone depletion, and climate change. These results, combined with increased awareness of complexities involved in marine management led to the creation of the United States Commission on

Ocean Policy (USCOP). By 2004 the commissions had published a report titled “An Ocean Blueprint for the 21st Century”. Several recommendations outlined in the report, such as Regional and State management reform and Fisheries Management reform have been implemented to better manage shared regional resources (94th Committee on Commerce, 1976).

4.6.2 | Conservation in Mexico

Environmental legislation in Mexico is included in the Constitution, national laws, and through executive action (SEMARNAT, 2003). Moving toward the Sea (Marcha al Mar) was the first marine policy program established in Mexico in 1959. This policy succeeded in the management of pollution from the nation’s oil fleet, but failed to incorporate other areas of concern including: fishing, farming, and tourism. In 1988 the General Law of Ecological Equilibrium and Environmental Protection (LGEEPA) was established, and it is considered the first comprehensive environmental law in Mexico which includes provisions for land-use, environmental regulations, and ecological zoning (SEMARNAT, 2007; Nash & McLaughlin, 2014). Similar to the United States, a system of various governmental laws and agencies has been established to oversee management of coastal areas. The Comisión Nacional de Areas Naturales Protegidas (CONANP), is responsible for management of the Natural Protected Areas in Mexico. Biodiversity knowledge in both marine and terrestrial areas is overseen by CONABIO, which also gathers information and promotes activities aimed at increasing the knowledge of biological diversity, while focusing on the conservation and sustainable use in marine and terrestrial areas. And finally, the Comisión Nacional de Acuacultura y Pesca

(CONAPESCA) which oversees the management of fisheries (Baur et al., 2018; DOF, 2018).

In 2006 and 2007, President Felipe Calderon established two different initiatives to address management of marine ecosystems in Mexican Waters. The first, the Convenio Marco para el Ordenamiento Ecológico Marino y Regional del Golfo de México y Mar Caribe (General Agreement for the Marine and Regional Ecological Management) was an agreement between federal agencies and the three Gulf states which outlined regional conservation and management agendas. The Estrategia Nacional para el Ordenamiento Ecológico del Territorio en Mares y Costas (National Strategy for Ecological Management for Coasts and Seas) further sought to organize the management and conservation goals of maritime policy in Mexico (Cruz & McLaughlin, 2008). While these two pieces of legislation were significant improvements to marine conservation efforts, more work still needs to be done in the areas of management gaps, integration of laws, and enforcement to provide a more holistic approach to coastal and ocean management in Mexico (Sevilla et al., 2018; Baur et al., 2018). In 2018 under the administration of President Enrique Peña Nieto the "Política nacional de mares y costas" was published as an integral management instrument that strengthens, guides and supports the planning and ordering of the seas and coasts, in order to make the decision-making processes more efficient and effective and to enhance sustainable development.

Besides these laws, there are other important instruments which integrate a specific set of regulations and definitions for protection of the environment and natural resources. These include the Mexican Official Norms (Normas Officiales Mexicanas). The most relevant is NOM-059-SEMARNAT-2010 for the flora and fauna, which lists

species under protection in Mexico (Sevilla, 2018); unfortunately, very few marine species are included. There are also NOMs for various environmental activities and also for some fisheries. In July 2020, the SEMARNAT proposed the Sectorial Program on the Environment and Natural Resources (PROMARNAT) 2019-2024, as a strategy to advance the agenda regarding the environment by the Federal Government. The PROMARNAT is aligned to the 2030 Agenda for Sustainable Development (Kritzer et al., 2014).

4.6.3 | Conservation in Cuba

Due to the geopolitical situation and slow economic growth since the 1960s, as well as a focus on sustainable development, Cuba has some of the best preserved marine ecosystems in the Caribbean and Gulf of Mexico regions (Gerbartz-Muro et al., 2018; Cuba Constitution, 1976). In 1976 Cuba created the Comisión Nacional para la Protección del Medio Ambiente y los Recursos Naturales (COMARNA, the National Commission for the Protection of Environmental and Natural Resources) as a way to better organize environmental management in Cuba (Cruz & McLaughlin, 2008; Whittle et al., 2003). Additionally, after the Rio Earth Summit in 1992, Cuba added several environmental laws to the country's constitution (Baur et al., 2018). Since then, multiple environmental policies and laws governing the management of marine ecosystems have been added. These include Law 81/1997, Decree Law 200/1999, Decree Law 201/1999, Decree Law 212/2000, Law 129/2019, which focus respectively on integration of marine, coastal, and freshwater management, creation of national MPAs, marine fisheries harvest controls, and oversight of enforcement of existing laws (Baur et al., 2018; Cuba Constitution, 1976). In 2019, the review and approval of the new Cuban fishing law (Law

129/2019) was completed, repealing the old Fishing Regulation (Law 164/1994). The new Law promotes science-based actions to assess fishery resources and provides a legal framework to develop and implement management measures that can guarantee their sustainability (González, Perrera, and Rojas pers comm, 2020).

Currently, the principal legislation governing the environment in Cuba is Environmental Law 81. This law provides the framework, policies and procedures needed to implement and enforce the countries sustainability and conservation goals, mainly granting the ability to establish national MPAs under article 89 and 90 of the national constitution (Perera-Valderrama et al., 2020). Under the Sistema Nacional de Areas Protegidas (National System of Protected Areas) (SNAP), the, Cuba is currently managing, to varying degrees, a total of 70 MPAs which represent 25% of Cuban waters (Humphreys & Clark, 2020). The creation of these MPAs in combination with the National Environmental Strategy and National Goals on Biodiversity helped to further the goals outlined in Cuba's National Environmental Policy (Humphreys & Clark, 2020). The current structure of the SNAP provides a good framework for protection, but despite the establishment of the 70 MPAs, many of the protections are focused on terrestrial areas. Additionally, the enforcement is still ineffective due to limited economic and human resources in the MPAs. Steps need to be taken to identify new marine policy gaps and improve existing management strategies consistent with developmental goals (González, Perrera, and Rojas, pers comm 2020).

4.7 | Framework for Trinational Regional Conservation Effort in the Gulf of Mexico Region

Several previous official and non-official initiatives have considered the creation of a framework for conservation efforts in the Gulf of Mexico LME focusing on the creation or expansion of marine protected areas (MPAs) (Nash &McLaughlin, 2012; Baur et al., 2018; Cruz & McLaughlin, 2008; DOF, 2018). The creation of MPAs for local and regional conservation has increased since the Rio Earth Summit in 1992, and has gained currency under the CBD-led Aichi Targets as Target 11 represents a call to effectively conserve at least 10% of coastal and marine areas by 2020 (Humphreys and Clark, 2020; UNEP-WCMC & IUCN, 2020). Some important mechanisms proposed by the CBD parties for achieving Aichi Biodiversity Target 11, is the use of Ecologically of Biologically Significant Marine Areas (EBSAs) and the strengthening of the scientific basis for areas-based management tools (ABMTs) in coastal and marine areas such as MPAs and other effective area-based conservation measures (OECMs). Prior to Aichi Target 11, coastal and protected areas had been designated in the form of national parks and preserves for the better part of a century in the GoM. After 1992, a target of 10% global MPA coverage was established, and currently MPAs cover 7.4% or 115,339 km2 of the GoM's 1,544,000km^2 marine area (Figure 5) (WDPA 2020). A comprehensive set of policies, similar to those already found in the Cartagena Convention, would help to address those areas currently not protected and help to align marine conservation interests in the United States, Mexico, and Cuba. This would allow for each country to build the framework on existing national policies in addition to regional MoUs while recognizing cultural, economic, and stake holder interests.

4.7.1 | Gaps in Conservation Law in the Gulf of Mexico Region

In the Gulf of Mexico, national and regional differences in economics, values, fishing, waste management, and conservation practices all need to be taken into consideration when building a tri-national conservation agreement. Since 1906, there have been 59 bilateral and multilateral environmental agreements (Table 9). A comparison of these agreements across the Gulf region shows that issues such as border conservation and pollution, water rights, diseases, fishing rights, hazardous waste, oil spills, general conservation, land and sea based pollution, tourism, whaling, and general legal agreements have all been addressed (Mitchell et al., 2020). However, the Cartagena Convention, in addition to the Law of the Sea and CITES are the only international agreements governing conservation-related issues across the Gulf of Mexico LME.

Additional memorandums of understanding involving both marine and terrestrial areas have been signed and impact regional conservation efforts. For example, the United States and Cuba signed a Memorandum of Understanding in 2015 to build a cooperative relationship on MPAs by creating a Sister Sanctuaries Program. A second Joint Statement in 2017 called for greater cooperation on environmental issues including those impacting marine and coastal areas and oil spill prevention and response (Baur et al., 2018). This was later signed becoming, the United States and Cuba Bilateral Oil Spill Preparedness and Response Agreement. Beginning in 2009, the United States and Mexico began the US-Mexico joint Gulf of Mexico Large Marine Ecosystem Based Assessment and Management Project addressing the issues of pollution, fishery stock recovery, habitat restoration, climate change, and governance (Zaldívar-Jiménez et al., 2017). The United

States and Mexico also have Sonoran Desert programs between bordering states and involving various conservation efforts and water management strategies (Radke, 2013).

Currently, the United States is the only signatory in the Gulf of Mexico to have ratified the Land Based Sources of Pollution protocol and both the United States and Cuba have signed and ratified the SPAW Protocol. Recent studies have concluded that runoff and land-based pollution is having a greater impact on the marine environment than previously thought (Macko, 2018;Soto et al., 2018;Wessel et al., 2016), and there are several large outflows in the Gulf of Mexico region that are heavily impacted by land-based sources. One such example, the Gulf of Mexico Dead Zone is created by outflow from the Mississippi River and during the summer months, this anoxic zone can reach up to 150 miles offshore. Recent U.S. legislation has attempted to curb the amount and type of runoff entering the system, however, many of these pollutants are coming from hundreds of miles inland and additional measures are needed (Rabotyagov et al., 2014). Any future tri-national agreement will need to address non-point source pollution and its role in the degradation of the marine ecosystem in the Gulf of Mexico LME.

Additionally, certain species, and species groups are facing pressures within the Gulf of Mexico LME. Marine bony and elasmobranch fishes are threatened by over fishing, bycatch, habitat degradation, and habitat loss (Strongin et al., 2020). Various conservation laws and regulations have been enacted; however, these regulations may not be applied to the same degree across the region possibly putting regional populations at additional risk of exploitation (Cruz & McLaughlin, 2008; Chagaris et al., 2019; Mackelworth et al., 2019). The impact that fisheries are having on both ecosystems and communities is strongly linked showing the social-ecological nature of this complex

system (Berkes, 2012; Lindkvist et al., 2019). However, depending on the country, both large commercial fisheries and the small artisanal fisheries have been highly subsidized providing incentive for continued business as usual practices (Sumaila et al., 2010; Sumaila et al., 2019). Additionally, the larger fleets of the United States are better equipped to exploit the fisheries resources of the Gulf region (Rosenberg et al., 2006; Battista et al., 2018; Harrison, 2020). The impact of the recreational sport fishing industry in the United States has also been highlighted in recent years, but additional studies will be necessary to understand the impact of sport fishing across Gulf populations (Lewin et al., 2019). This is a contrast to the fleets of Mexico, which have a larger number of artisanal fishers and fewer regulations regarding fisheries resources. However, there are regulations currently in place, like those for tunas, that apply to both artisanal fisheries as well as larger fleets which may be used as a model moving forward (Hernández et al., 1999). In Cuba there is strong legislation on fishing matters but its enforcement is difficult due to the lack of financial resources. Nevertheless, Cuba's new fisheries law offers a great opportunity to improve the connections between science and management. This innovative legal framework calls for the development and implementation of science-based measures guided by dialogue and consultation through an existing Committee on Fisheries (Consultative Fisheries Commission). This commission involves all actors related to the conservation and use of fishery resources, which allows collegiate decisions to be made that guarantee the sustainable use of fishery resources on the island. Since the law was just enacted in 2019, managers and decision makers still need to develop best practices and regulations for conservation and enforcement based on this

new legal framework. The country is working hard to ensure more and better interactions between scientists, fishermen and decision makers (Valderrama pers. com. 2021).

The above issues highlight several of the principal areas which will need to be incorporated into a more comprehensive Gulf of Mexico LME policy. Previous efforts at comprehensive LME policy, like those seen in the European Union, show the importance of international agreement when building environmental policy (Juda, 2007; Meiner, 2010). The Gulf of Mexico LME will benefit from a comprehensive approach when addressing marine biological conservation priorities, issues of sustainability, and regional environmental conflicts in areas such as pollution mitigation.

4.8 | Regional Frameworks

Cartagena was created under the UN Regional Seas Programme (RSP) which seeks regional cooperation in addressing issues relating to the marine and coastal environments. In addition, under this Programme mechanisms such as Regional Fisheries Bodies (RFBs) and Large Marine Ecosystems (LMEs) have been used to address specific concerns regarding various aspects of the marine environment (Billé et al., 2016). Similar to the Cartagena Convention, other regional agreements have been signed addressing conservation and environmental concerns. The Barcelona Convention System (BCS) is an agreement made up of a framework of 7 protocols concerning pollution, dumping, emergency maritime procedures, specially protected areas, biodiversity, offshore explorations, hazardous waste, and coastal management (Raftopoulos, 2011). When combined with the Mediterranean Action Plan (MAP), these Protocols outline environmental governance in the region. The success of cooperation toward environmental assessments, defining best environmental practices, and the integration of

management show the importance of conservation efforts and agreements on a regional scale. The importance of these agreements when moving toward holoistic conservation efforts in the GoM LME is an emphasis on focused sustainability efforts at both the national and regional level. The LME mechanisms approach has focused on ecosystem based management (EBM) on a regional scale including the use of ecosystem services while better understanding ecosystem structure and function. When used in combination with already existing agreements in the GoM, systems such as the RSP and the LME approach could provide a framework for a similar Gulf of Mexico LME Protocol system as proposed below. These protocols would expand upon current MEAs, such as Cartagena, while specifically addressing regional threats and conservation gaps in the GoM. This proposed framework would allow for regional negotiations between governemental institutions overseeing various areas of management, such as fisheries and resources, based on current areas of concern including reservations within the Cartagena Protocols in the GoM.

4.8.1 | Proposed GoM LME protocol to address land based sources of pollution, including non-point source and plastics

Currently, the United States and Mexico have ratified the LBS Protocol. In Cuba, adherence to the LBS Protocol is in the process of being approved. The related procedures have been delayed due to recent changes which have occurred in the country and the legislative which has taken place in recent years. However, while the Protocol is not ratified, decision makers in Cuba adhere to the spirit of the Protocol (Valderrama pers. com. 2021). The objective of a proposed Protocol for the three GoM states will be to combine current national and regional pollution policies, such as the PNMC in

Mexico, with those already outlined in the LBS, while focusing on the control and reduction of pollutants impacting the Gulf. Current scientific information shows that marine pollutants, including organo-phosphates, plastics, and petrochemicals pose a substantial risk to the marine environment (Polidoro et al., 2020). The LBS currently recognizes chemicals of concern for the marine environment (Table 10). The continued discharge and/or release of listed chemicals will be subject to authorization and approval according to the guidance provided within the context of this proposed protocol in addition to current pollution agreements between the United States Mexico and Cuba. By combining the currently recognized LBS Protocols with Gulf specific concerns, efforts can be taken to reduce or completely eliminate chemicals known to be toxic and/or bioaccumulate within the environment in the GoM LME. Specific regional considerations will need to be addressed such as the agreements regarding the discharge and use of the waters of the Rio Grande River. This will allow for a region specific approach to the prevention and/or control of discharges from rivers, outfalls, coastal infrastructure, industrial activities, and any other land based sources within or under the control of the countries of the Gulf. In addition, a regional Litter Management plan will be established which will include specific guidance for the handling and disposal of land based sources of litter including the reduction in plastic marine debris.

4.8.2 | Proposed protocol to designate marine protected areas in the Gulf of Mexico LME

The objective of this proposed protocol will be to build on the current Memorandum of understanding which exists between the United States and Cuba regarding the Sister Sanctuaries Program. A similar agreement between Cuba and

Mexico, the MPA Memorandum of Understanding, was signed in 2018. These agreements will be expanded across all waters of the Gulf of Mexico while recognizing the importance of creating and managing marine protected areas. Each country will designate areas of unique biodiversity and importance to cultural or national heritage as already outlined in the current agreements. These protected areas will also include, but are not limited to, known spawning grounds or habitats of species recognized as being endangered in the Gulf of Mexico. Further, the three countries will agree to a common set of conservation guidelines to include restrictions on commercial, recreational, and artisanal fisheries, development, resource exploration, and tourist activities.

The governance and regulation of activities in these areas will require approval from a Gulf MPA board to be established by this protocol and consist of marine scientists and managers from each country. Political entities and/or those with special interests may not serve as members of this board. The responsibilities of this board will be to develop common practices for the creation of MPAs, facilitate the exchange of scientific information, establish common practices regarding monitoring and enforcement within Gulf MPAs, and maintain a network of sister sanctuaries while continuing to better understand the interconnectivity of marine populations within the Gulf.

4.8.3 | Proposed GoM LME protocol to recognize protected species and biodiversity

Currently, there is not a regionally recognized list of protected species endemic to the Gulf (Strongin et al., 2020). The establishment of a Gulf Protected Species List, within the context of this protocol, will provide the criteria necessary for identifying those species in need of special protections and those species of commercial or political importance will not receive preferential treatment under these guidelines. Additionally,

many commercial species in the Gulf have trans-boundary ranges but current management practices may differ across international borders. This Protocol will allow for the creation of consistent guidelines regarding stock assessments, fishing practices, and conservation protocols across the three GoM states.

Areas recognized as marine protected areas under this proposed protocol to will manage all endemic flora and fauna within these areas to maintain or enhance their populations. Current data will be combined with the guidelines created for defining protected species, protected areas, and CITES regulations of which this latter instrument all three countries nations are signatories, so the trade, protection, commercial use and/or sale, of species of flora and fauna will be more consistently regulated throughout the region.

4.8.4. | Proposed GoM LME protocol to combat maritime waste from ships

The MARPOL Convention, which places regulations on ship-generated wastes, is the only internationally recognized agreement currently operating in the Gulf. The implementation and enforcement of this agreement however differs from others because for the standards to be binding, member countries, representing a minimum of 50% of the world's gross tonnage in shipping, must first ratify the agreement. Non-ratifying member nations are then given an opportunity to object. If a member state has not objected, they are assumed to have accepted the treaty and associated annexes (Karim, 2015). Cuba and Mexico currently do not recognize MARPOL Annexs III, IV, or VI. Additional governing practices within the GoM LME, such as the Oil Pollution Act (OPA) also allow for deviations from MARPOL (Ayorinde, 1994).

The purpose of this proposed protocol will be to create a set of standardized regulations for pollution generated from shipping activities in the GoM LME including those not currently recognized under MARPOL. These regulations will cover shipping from cargo ships, those carrying oil from offshore rigs, and aircraft. Cargo ships will be required to keep waste stored onboard until arriving in port. All ports will be required to maintain waste removal facilities for both human waste and waste generated due to shipping activities and fines will be associated with improper dumping. As of 2015, MARPOL regulations have also included emission standards for all ships in addition to the 2020 guidelines for sulfer dioxide.

4.8.5 | Proposed GoM LME protocol for cooperation to combat oil spills and management

The United States, Mexico, and Cuba have ratified the Oil Spills Protocol from the Cartagena Convention. Political dynamics in the Gulf have led to strained relations and gaps in oil spill preparedness and response in recent years. Currently, the United States and Mexico have an "Agreement Of Cooperation Between Mexico And The United States On The Contamination Of The Marine Environment By Hydrocarbon Spills And Other Harmful Substances" (MEXUSGULF) which outlines the policies and procedures needed during a an oil spill or pollution incident involving both countries. There are currently no similar agreements between the United States and Cuba or Mexico and Cuba. Therefore, this protocol will combine the Annexes of the Cartagena Convention Oil Spills Protocol with those of the MEXUSGULF to specifically address oil spills as these spills will have various impacts on the GoM LME including impacting fisheries, ecosystem management, in additional to other shared reources. The

MEXUSGULF outlines coordination and levels of command between the US and Mexico including various zones between the two countries. The new tri-national protocol will add levels of command for spills occurring in or adjacent to Cuban waters and add similar levels of command within the Cuban response system. Additionally, joint responses will now include response teams from all three countries, and all necessary resources including well capping equipment, skimmers, booms, dispersants, vacuums, and storage tanks. Spill response equipment will be readily available and shared when necessary to properly respond to a petrochemical accident.

5 | Conclusion

Many environmental issues in this work listed protocols already recognized by at least one of the countries of the Gulf either at a national or international level. Recent improvements in relations between the United States and Cuba starting in 2018, and agreements already in place between both Mexico and Cuba and Mexico and the United States provide an opportunity to begin working toward a tri-national conservation agreement in the Gulf. Previous studies have focused on the need for MPAs to address conservation strategies in the Gulf; however, as outlined in the previous sections, there are numerous conservation gaps that need to be addressed to create holistic conservation management in the region. By combining elements of current agreements into one framework that better reflects the Gulf, the proposed tri-national agreement would allow for a unified approach when addressing various areas of conservation concern.

In recent years, more emphasis has been placed on ecosystem-based fisheries management (Hall & Mainprize, 2004) and more integrated conservation efforts when moving toward sustainable solutions (Jacob et al., 2020; Kelly et al., 2020). These new

management efforts have been implemented in various forms throughout the Gulf; however, as outlined above, need additional measures to move toward uniform implementation and enforcement. The inclusion of multiple impacts on the ecosystem, input from various stakeholders and scientists in these three countries, and building on currently ratified agreements will allow for any conservation agreement to better represent the various ecosystems, stakeholders, and interests of the people. The benefit of successful management of MPAs, protected species, fisheries, pollution, and oil activities is of mutual benefit to all three countries. The continued improvement of diplomatic relations will be needed for a successful implementation of any tri-national conservation agreement.

Table 8: Country ratification dates for all Protocols of the Cartagena Convention. Special Protected Areas and Wildlife (SPAW) Protocol, Land-Based Sources of Pollution (LBS).

Country	Date of Ratification or Accession		
	Cartagena Convention and Oil Spills Protocol	SPAW Protocol	LBS Protocol
Antigua and Barbuda	11-Sep-86		13-Jul-10
The Bahamas	24-Jun-10	24-Jun-10	24-Jun-10
Barbados	28-May-85	14-Oct-02	
Belize	22-Sep-99	4-Jan-08	4-Feb-08
Colombia	3-Mar-88	5-Jan-98	
Costa Rica	1-Aug-91		26-May-16
Cuba	15-Sep-88	4-Aug-98	
Dominica	5-Oct-90		
Dominican Republic	24-Nov-98	24-Nov-98	6-Sep-12
France	13-Nov-85	5-Apr-02	4-May-07
Grenada	17-Aug-87	5-Mar-12	5-Mar-12
Guatemala	18-Dec-89		
Guyana	14-Jul-10	14-Jul-10	14-Jul-10
Haiti			
Honduras	13-Oct-18	13-Oct-18	13-Oct-18
Jamaica	1-Apr-87		5-Nov-15
Mexico	11-Apr-85		
Netherlands	16-Apr-84	2-Mar-92	
Nicaragua	25-Aug-05		
Panama	6-Nov-87	27-Sep-96	9-Jul-03
St. Kitts and Nevis	15-Jun-99		
Saint Lucia	30-Nov-84	18-May-00	30-Jan-08
St. Vincent and the Grenadines	11-Jul-90	26-Jul-91	
Suriname			
Trinidad and Tobago	24-Jan-86	10-Aug-99	28-Mar-03
United Kingdom	28-Feb-86		
United States of America	31-Oct-84	16-Apr-03	13-Feb-09
Venezuela	18-Dec-86	28-Jan-97	

Table 9: Current Bilateral and Multilateral Environmental Agreements Specific to the Gulf of Mexico or Greater Caribbean Region (Mitchell 2020; Mitchell et al. 2020).

Inclusion	Countries Involved	Agreement Name	Signatures	Entry into force	Agreement Termination (if any)	Ratifications (or similar)
BEA	USA / Mexico	Convention Between The United States of America And Mexico Concerning The Distribution Of Waters Of The Rio Grande	5/21/1906	1/16/1907		
BEA	USA / Mexico	Convention between the United States of America and Mexico to prevent smuggling and for certain other objects	12/23/1925			
BEA	USA / Mexico	Supplementary Protocol To The Treaty Relating To The Utilization Of the Waters Of the Colorado And Tijuana Rivers And Of The Rio Grande (Rio Bravo) from Fort Quitman, Texas, to the Gulf of Mexico	11/14/1944	11/8/1945		
BEA	USA / Mexico	Treaty Relating To The Utilization Of the Waters Of the Colorado And Tijuana Rivers And Of The Rio Grande (Rio Bravo) from Fort Quitman, Texas, to the Gulf of Mexico	11/14/1944	11/8/1945		
BEA	USA / Mexico	Convention Between The United States of America And Mexico relating to the establishment of an International Commission for the Scientific Investigation of Tuna	1/25/1949	7/11/1950		
BEA	USA / Mexico	Exchange Of Notes Constituting An Agreement Between The United States of America And Mexico Relating To The Establishment Of A Mexican-United States Commission For The Prevention Of Foot And Mouth Disease	8/26/1952	8/26/1952		
BEA	USA / Mexico	Agreement Effected By Exchange Of Notes Between Mexico And The United States of America Concerning The Loan Of Colorado River Waters For Irrigation Of Lands In The Mexicali Valley	8/24/1966	8/24/1966		
BEA	USA/ Mexico	Exchange Of Notes Constituting An Agreement Between The United States of America And Mexico On Traditional Fishing In The Exclusive Fishery Zones Contiguous To The Territorial Seas Of Both Countries	10/27/1967	1/1/1968		
BEA	USA / Mexico	Exchange Of Notes Constituting An Agreement Between The United States of America And Mexico Regarding The Colorado River Salinity Problem	11/16/1970	11/16/1970		
BEA	USA / Mexico	Agreement Between The United States of America And Mexico Effected By Exchange Of Notes Relating To The Colorado River Salinity	11/15/1971	11/15/1971		
BEA	USA / Mexico	Fishing Agreement Between The United States of America And Mexico	11/24/1976	11/24/1976		
BEA	USA / Mexico	Agreement between the Government of the United States of America and the Government of Mexico concerning Fisheries off the Coast of the United States	8/26/1977	10/7/1977	7/1/1982	
BEA	USA / Mexico	Agreement Of Cooperation Between Mexico And The United States On The Contamination Of The Marine Environment By Hydrocarbon Spills And Other Harmful Substances	7/24/1980	3/30/1981		
BEA	USA / Mexico	Agreement Between The United States of America And The United Mexican States On Cooperation For The Protection And Improvement Of The Environment In The Border Area	8/14/1983			
BEA	USA / Mexico	Agreement of cooperation between the United States of America and the United Mexican States regarding pollution of the environment along the inland international boundary by discharges of hazardous substances	7/18/1985			
BEA	USA / Mexico	Agreement Of Cooperation Between The United States of America And The United Mexican States Regarding Pollution Of The Environment Along The Inland International Boundary By Discharges Of Hazardous Substances	7/18/1985			
BEA	USA / Mexico	Agreement Of Cooperation Between Mexico And The United States On Transfrontier Air Pollution Caused By Copper Smelters Along Their Common Border	1/29/1987	1/29/1987		

Inclusion	Countries Involved	Agreement Name	Signatures	Entry into force	Agreement Termination (if any)	Ratifications (or similar)
BEA	USA / Mexico	Agreement Between Mexico And The United States For Cooperation On Environmental Programs And Transboundary Problems, Annex III, Transboundary Shipment Of Hazardous Wastes And Hazardous Substances	11/12/1986	1/29/1987		
BEA	USA / Mexico	Boundary Waters Agreement Between The United States of America And Mexico Of 1987	11/10/1987			
BEA	USA / Mexico	Agreement Between The Government Of The United States of America And The Government Of The United Mexican States On Cooperation For The Protection And Improvement Of The Environment In The Metropolitan Area Of Mexico City	10/3/1989			
MEA	USA / Mexico	Cooperative agreement among the United States, Canada and Mexico supplementary to the North American plant protection agreement	10/20/1989	10/20/1989	10/20/1991	
MEA	USA / Mexico	Cooperative agreement among the United States, Canada and Mexico supplementary to the North American plant protection agreement	10/20/1991	10/20/1991		
BEA	USA / Mexico	Agreement Between Mexico And The United States To Replace The Appendices Of Annex V Of The Agreement On Cooperation For The Protection And Improvement Of The Environment In The Border Zone	5/7/1996	5/7/1996		
MEA	USA / Mexico	Amendments To The International Convention For The Safety Of Life At Sea - Adoption of Resolution and Annexes on Ship Reporting Systems for North Atlantic Right Whales off the Northeastern and Southeastern Coasts of the United States		7/1/1999		
BEA	USA / Mexico	Agreement Modifiying The Agreement Of Cooperation Between The United States of America And The United Mexican States Regarding Pollution Of The Environment Along The Inland International Boundary By Discharge Of Hazardous Substances And Annex II Of The Agreement Between The United States of America And The United Mexican States On Cooperation For The Protection And Improvement Of The Environment In The Border Area	6/4/1999	6/4/1999		
BEA	USA / Mexico	Protocol of Amendment to the Agreement Between the Government of the United States of America and the Government of the United Mexican States Concerning the Establishment of a Border Environment Cooperation Commission and a North American Development Bank	11/25/2002			
MEA	USA / Mexico	Convention For The Strengthening Of The Inter-American Tropical Tuna Commission Established By The 1949 Convention Between The United States Of America And The Republic Of Costa Rica	11/14/2003	8/27/2010		1/14/2005
MEA	USA / Mexico	Cooperative agreement among the United States, Canada and Mexico supplementary to the North American plant protection agreement	10/17/2004	10/17/2004		
BEA	USA / Mexico	Cooperative Agreement between the Peace Corps of the United States of America and the Ministry of Environment and Natural Resources of the United Mexican States	6/13/2006	6/13/2006		
BEA	USA / Mexico	Agreement between the United Mexican States and the United States of America concerning transboundary hydrocarbon reservoirs in the gulf of Mexico	2/20/2012	7/18/2014		
BEA	Mexico / Cuba	Fisheries Agreement Between The United Mexican States And The Republic Of Cuba	7/26/1976	7/26/1976		
BEA	USA / Cuba	Convention Between The United States of America And Cuba For The Conservation Of Shrimp	8/15/1958	9/4/1959		

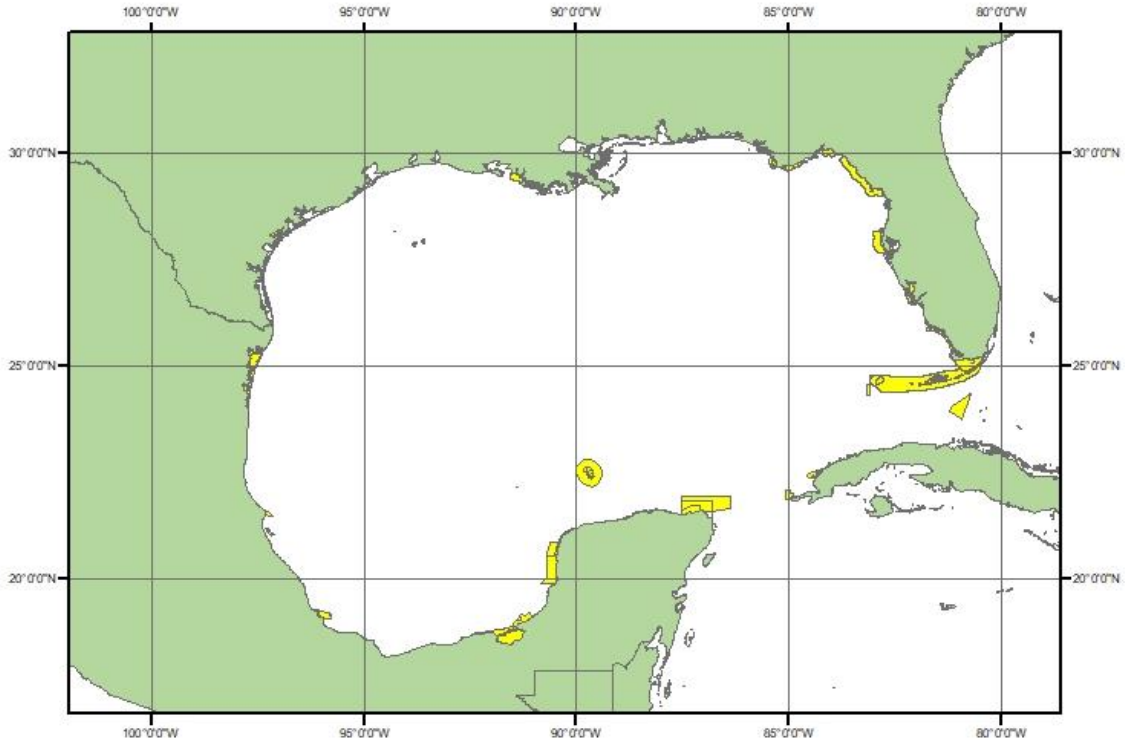
Inclusion	Countries Involved	Agreement Name	Signatures	Entry into force	Agreement Termination (if any)	Ratifications (or similar)
BEA	USA / Cuba	Agreement Between The Government Of The United States of America And The Government Of The Republic Of Cuba Concerning Fisheries Off The Coasts Of The United States	4/27/1977	9/26/1977	9/26/1982	
MEA	USA / Cuba	Amendments To The International Convention For The Safety Of Life At Sea - Adoption of Resolution and Annexes on Ship Reporting Systems for North Atlantic Right Whales off the Northeastern and Southeastern Coasts of the United States		7/1/1999		
MEA	Cartagena Convention / USA	Convention For The Protection And Development Of The Marine Environment Of The Wider Caribbean Region	3/24/1983	10/11/1986		9/6/1984
MEA	Cartagena Convention / Mexico	Convention For The Protection And Development Of The Marine Environment Of The Wider Caribbean Region	3/24/1983	11/11/1986		4/11/1985
MEA	Cartagena Convention / USA	Protocol Concerning Cooperation In Combating Oil Spills In The Wider Caribbean Region	3/24/1983	10/11/1986		10/31/1984
MEA	Cartagena Convention / Mexico	Protocol Concerning Cooperation In Combating Oil Spills In The Wider Caribbean Region	3/24/1983	10/11/1986		4/9/1985
MEA	Cartagena Convention / Cuba	Protocol Concerning Cooperation In Combating Oil Spills In The Wider Caribbean Region		10/15/1988		9/15/1988
MEA	Cartagena Convention / USA	Protocol Concerning Specially Protected Areas and Wildlife to the Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region	1/18/1990	4/16/2003		4/16/2003
MEA	Cartagena Convention / Mexico	Protocol Concerning Specially Protected Areas and Wildlife to the Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region	1/18/1990			
MEA	Cartagena Convention / Cuba	Protocol Concerning Specially Protected Areas and Wildlife to the Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region	1/18/1990	6/18/2000		8/4/1998
MEA	Cartagena Convention / USA	Amendments To Annex V Regarding The Wider Caribbean As Special Area To The International Convention For The Prevention Of Pollution From Ships		4/4/1993		
MEA	Cartagena Convention / Mexico	Amendments To Annex V Regarding The Wider Caribbean As Special Area To The International Convention For The Prevention Of Pollution From Ships		10/15/1998		
MEA	Cartagena Convention / USA	Protocol Concerning Pollution From Land-Based Sources And Activities to the Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region	10/6/1999			
MEA	Cartagena Convention / USA	Protocol Concerning Pollution From Land-Based Sources And Activities to the Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region		8/13/2010		2/13/2009
MEA	Caribbean / Cuba	Convention For The Protection And Development Of The Marine Environment Of The Wider Caribbean Region		10/15/1988		9/15/1988
MEA	Caribbean / Mexico	Amendment To The Treaty For The Prohibition Of Nuclear Weapons In Latin America (adding "and the Caribbean" to the title)	11/5/1990	10/24/1991		10/24/1991
MEA	Caribbean / Cuba	Amendments To Annex V Regarding The Wider Caribbean As Special Area To The International Convention For The Prevention Of Pollution From Ships		5/12/2002		
MEA	Caribbean / Cuba	Amendment To The Treaty For The Prohibition Of Nuclear Weapons In Latin America (adding "and the Caribbean" to the title)	12/5/1995			

Inclusion	Countries Involved	Agreement Name	Signatures	Entry into force	Agreement Termination (if any)	Ratifications (or similar)
MEA	Caribbean / Mexico	Constitution Of The Centre For Marketing Information And Advisory Services For Fishery Products In Latin America And The Caribbean		3/26/1997		3/26/1997
MEA	Caribbean / Mexico	Convention Establishing the Association of Caribbean States	7/24/1994	8/4/1995		4/28/1995
MEA	Caribbean / Cuba	Amendment To The Treaty For The Prohibition Of Nuclear Weapons In Latin America (adding "and the Caribbean" to the title)	12/5/1995			
MEA	Caribbean / Cuba	Convention Establishing the Association of Caribbean States	7/24/1994	8/4/1995		7/5/1995
MEA	Caribbean / Mexico	Convention Establishing The Sustainable Tourism Zone Of The Caribbean	12/12/2001	11/6/2013		11/11/2003
MEA	Caribbean / Cuba	Convention Establishing The Sustainable Tourism Zone Of The Caribbean	12/12/2001	11/6/2013		10/18/2005
MEA	Caribbean / Mexico	Protocol to the Convention Establishing The Sustainable Tourism Zone Of The Caribbean	2/12/2004			5/13/2005
MEA	Caribbean / Cuba	Protocol to the Convention Establishing The Sustainable Tourism Zone Of The Caribbean	2/12/2004			
MEA	Caribbean / USA	Amendments to the Protocol Adopting Annex VI - Regulations For The Prevention Of Air Pollution From Ships To The International Convention For The Prevention Of Pollution From Ships - Designation of the United States Caribbean Sea Emission Control Area and exemption of certain ships operating in the North American Emission Control Area and the United States Caribbean Sea Emission Control Area under regulations 13 and 14 and Appendix VII of MARPOL Annex VI		1/1/2013		
MEA	Caribbean / Mexico	Regional Agreement on Access to Information, Public Participation and Justice in Environmental Matters in Latin America and the Caribbean	9/27/2018			

Table 10: Substances and/or families of substances known to be toxic, persistent, or bioaccumulate within the marine environment which will be regulated under the Land Based Sources Protocol to the Gulf of Mexico Trinational Agreement. This list was originally created under the Annex I of the Cartagena Conventions Land Based Sources Protocol and has been modified to better reflect the pollutants of increased importance in the Gulf of Mexico Region.

Pollutant	**Description**
Organohalogens	Any substance which is or may form such compounds in the marine environment
Organophosphates	Any substance which is or may form such compounds in the marine environment
Organotin	Any substance which is or may form such compounds in the marine environment
Mercury	Mercury and/or mercury compounds
Oils	To include crude and refined oils in addition to used oil products
Radioactive Materials	Any substance or its waste which when discharged does not comply with current international guidelines
Pesticides and Herbicides	Any substance utilized as a pesticide which may cause additional environmental impacts upon discharge
Nitrogen Based Products	Any substance which may lead to eutrophication of the marine environment
Non-Toxic Substances	Substances which may interfere with the legitimate use of the sea or have adverse effects on the physical or chemical characteristics of seawater.
Additional Regulated Substances	
Polycyclic Aromatic Hydrocarbons	
Heavy Metals and related compounds	
Pathogenic microorganisms	
Cynaides and fluorides	
Non-biodegradable deetergents	
Thermal discharges	
Acidic or Alkaline compouds which may interfere with water quality	

Figure 5: Current MPA Coverage Within the Gulf of Mexico.



CHAPTER 4

CONCLUSION

Conservation priority species, such as those listed under the U.S. Endangered Species Act and the Mexico NORMA 59, highlight those species at greatest risk in the Gulf to identified threats such as directed fishing, habitat loss, industrial development, pollution and bycatch. This study has shown, many species that are listed in a threatened category at the global scale are not recognized by regional conservation efforts. Moving forward, the integration of information from both regional threats and global-level extinction risk assessments needs to inform local or regional scale conservation initiatives. Specifically, managers and stakeholders can incorporate assessments into action plans focused on ecosystem based management. It will be important to future ecosystem-based research and management planning to create ecosystem models which better represent specific ecosystems or regions. In this approach, trophic models can be used as a baseline ecosystem to analyze various management strategies in addition to downstream tropich impacts which may not be highlighted by previous studies. This allows future conservation strategies to highlight those species currently in need of additional regional protections by combining extinction risk assessments, regional interests, and ecosystem models.

Recent improvements in relations between the countries of the Gulf of Mexico LME in addition to agreements already in place provide an opportunity to incorpoate the above methods into a regional conservation agreement. The emphasis on MPAs as a means to address conservation concerns in the Gulf has been highlighted in previous chapters, however, the identified conservation gaps also need to be addressed when

considering ecosystem based management strategies. This includes the successful management of MPAs, implementing species protections, creating regulations regarding fisheries, pollution, and oil activities which are all linked to social, economic, and the national interests the countries of the Gulf of Mexico LME. By combining elements of current agreements in addition to available scientific data into one framework that better reflects the Gulf, the proposed tri-national agreement would allow for a unified approach moving toward conservation in the Gulf of Mexico LME.

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APPENDIX A

SEABIRD SPECIES LIST AND ASSOCIATED DATA

Genus species	Global RL	Common Group	Functional Group	NOAA NRDA Data (count)	Avg. Adult Weight (g) *Birds of N. America	Northern Estimates NRDA(g)	Northern Estimates (OBIS)	Northern Biomass (g)	Northern Biomass (t)	Northern Estimate t/km^2
Aythya marila	LC	Duck	Seabirds		1000	0	10	10000	0.010231	1.28E-08
Bucephala clangula	LC	Duck	Seabirds		900	0	10	9000	0.009208	1.16E-08
Melanitta perspicillata	LC	Duck	Seabirds		975	0	10	9750	0.009975	1.25E-08
Mergus merganser	LC	Duck	Seabirds		1465	0	10	14650	0.014988	1.88E-08
Mergus serrator	LC	Duck	Seabirds		1075	0	10	10750	0.010998	1.38E-08
Anous minutus	LC	Seagull	Seabirds		110	0	0	0	0	0
Anous stolidus	LC	Seagull	Seabirds	16	180	2880	29	5220	0.005341	6.7E-09
Chlidonias niger	LC	Seagull	Seabirds	2323	55	127765	705	38775	0.039671	4.98E-08
Gelochelidon nilotica	LC	Seagull	Seabirds	18	182	3276	17	3094	0.003165	3.97E-09
Hydrocoloeus minutus	LC	Seagull	Seabirds		125	0	3	375	0.000384	4.81E-10
Hydroprogne caspia	LC	Seagull	Seabirds	4	656	2624	29	19024	0.019463	2.44E-08
Larus argentatus	LC	Seagull	Seabirds	1531	1025	1569275		1569275	1.605525	2.01E-06
Larus atricilla/Leucophaeus atricilla	LC	Seagull	Seabirds	6772	300	2031600	977	293100	0.299871	3.76E-07
Larus cirrocephalus	LC	Seagull	Seabirds			0	3	0	0	0
Larus delawarensis	LC	Seagull	Seabirds	15	550	8250	34	18700	0.019132	2.4E-08
Larus dominicanus	LC	Seagull	Seabirds			0	8	0	0	0
Larus fuscus	LC	Seagull	Seabirds		1650	0	11	18150	0.018569	2.33E-08
Larus glaucoides	LC	Seagull	Seabirds		945	0	7	6615	0.006768	8.49E-09
Larus marinus	LC	Seagull	Seabirds	2	1652	3304		3304	0.00338	4.24E-09
Larus philadelphia/Chroicocephalus philadelphia	LC	Seagull	Seabirds		210	0	12	2520	0.002578	3.23E-09
Larus pipixcan/Leucophaeus pipixcan	LC	Seagull	Seabirds	1	287	287	14	4018	0.004111	5.16E-09
Onychoprion anaethetus	LC	Seagull	Seabirds	86	145	12470	230	33350	0.03412	4.28E-08
Onychoprion fuscatus	LC	Seagull	Seabirds	871	200	174200	735	147000	0.150396	1.89E-07
Sterna dougallii	LC	Seagull	Seabirds	2	112	224	16	1792	0.001833	2.3E-09
Sterna forsteri	LC	Seagull	Seabirds	31	160	4960	15	2400	0.002455	3.08E-09
Sterna hirundo	LC	Seagull	Seabirds	1905	127	241935	23	2921	0.002988	3.75E-09
Sternula antillarum	LC	Seagull	Seabirds	23	45	1035	31	1395	0.001427	1.79E-09

Thalasseus maximus	LC	Seagull	Seabirds	1785	400	714000		714000	0.730493	9.16E-07
Thalasseus sandvicensis	LC	Seagull	Seabirds	1415	240	339600		339600	0.347445	4.36E-07
Phalaropus fulicarius	LC	Wader	Seabirds	1	55	55		55	5.63E-05	7.06E-11
Phalaropus lobatus	LC	Wader	Seabirds	21	36	756		756	0.000773	9.7E-10
Stercorarius longicaudus	LC	Skuas	Seabirds	2	295	590		590	0.000604	7.57E-10
Stercorarius parasiticus	LC	Skuas	Seabirds	18	445	8010		8010	0.008195	1.03E-08
Stercorarius pomarinus	LC	Skuas	Seabirds	79	700	55300	467	326900	0.334451	4.2E-07
Gavia immer	LC	Loon	Seabirds	51	5000	255000	11	55000	0.056271	7.06E-08
Pelecanus erythrorhynchos	LC	Pelicans	Seabirds	1	7200	7200		7200	0.007366	9.24E-09
Pelecanus occidentalis	LC	Pelicans	Seabirds	2693	3000	8079000	70	210000	0.214851	2.7E-07
Phaethon aethereus	LC	Tern-like	Seabirds	5		0		0	0	0
Phaethon lepturus	LC	Pelicans	Seabirds	1	350	350	21	7350	0.00752	9.43E-09
Podiceps auritus	VU	Grebes (diving birds)	Seabirds	108	435	46980	10	4350	0.00445	5.58E-09
Oceanodroma castro/Hydrobates castro	LC	Storm Petrel	Seabirds	35	42	1470		1470	0.001504	1.89E-09
Oceanodroma leucorhoa/Hydrobates leucorhous	VU	Storm Petrel	Seabirds	2	42	84		84	8.59E-05	1.08E-10
Oceanites oceanicus	LC	Wheatears	Seabirds	27		0	147	0	0	0
Calonectris diomedea	LC	Shearwater	Seabirds	61	544	33184		33184	0.033951	4.26E-08
Pterodroma hasitata	EN	Petrel	Seabirds	8		0	18	0	0	0
Puffinus gravis/Ardenna gravis	LC	Shearwater	Seabirds	66		0		0	0	0
Puffinus griseus/Ardenna grisea	NT	Shearwater	Seabirds	1		0		0	0	0
Puffinus lherminieri	LC	Shearwater	Seabirds	585		0	655	0	0	0
Fregata magnificens	LC	Frigate	Seabirds	344	1500	516000	28	42000	0.04297	5.39E-08
Phalacrocorax auritus	LC	Cormorants	Seabirds	100	1850	185000	54	99900	0.102208	1.28E-07
Phalacrocorax brasilianus	LC	Cormorants	Seabirds	6	1300	7800	4	5200	0.00532	6.67E-09
Morus bassanus	LC	Gannet	Seabirds	1026	3000	3078000	130	390000	0.399009	5.01E-07
Sula dactylatra	LC	Boobies	Seabirds	35	1786	62510	135	241110	0.24668	3.09E-07
Sula leucogaster	LC	Boobies	Seabirds	7	1375	9625	24	33000	0.033762	4.24E-08
Sula sula	LC	Boobies	Seabirds	5	975	4875	16	15600	0.01596	2E-08
Chroicocephalus philadelphia			Seabirds	90	210	18900		18900	0.019337	2.43E-08
			Seabirds	**22178**	**44911**	**17608374**	**4739**	**4779437**	**4.889842**	**6.13E-06**

APPENDIX B

BONY FISH SPECIES LIST AND ASSOCIATED DATA

Genus species	Global RL	Functional Group	Northern Estimates (NOAA SEAMAPS [kg])	Weight/Total Area Trawled (km2)	Northern Estimates (OBIS)	Average Adult Weight (kg)	Estimated Northern Biomass (kg)	Northern Biomass Estimate (t)	Northern Estimate t/km^2
Micropogonias furnieri	LC	Atlantic Croaker		0	1	0.05	0	0	0
Micropogonias undulatus	LC	Atlantic Croaker	14.258	0.011263355	84731	2.4	8977.895377	9.875684915	1.24E-05
		Atlantic Croaker	**14.258**		**84732**	**1.225**	**8977.895377**	**9.875684915**	**1.24E-05**
Thunnus thynnus	EN	Atlintic Bluefin			2485	684	1699740	1869.714	0.002346
		Atlintic Bluefin	**0**		**2485**	**684**	**1699740**	**1869.714**	**0.002346**
Anchoa mitchilli	LC	Bay Anchovy	737.95	0.58	126542.00	0.01	464666.22	511.13	0.00
		Bay Anchovy	**737.95**		**126542.00**	**0.01**	**464666.22**	**511.13**	**0.00**
Pogonias cromis	LC	Black Drum	1.28	0.00	7894.00	45.00	355230.00	390.75	0.00
		Black Drum	**1.28**		**7894.00**	**45.00**	**355230.00**	**390.75**	**0.00**
Makaira nigricans	VU	Blue Marlin		0.00	698.00	400.00	279200.00	307.12	0.00
Kajikia albida	VU	White Marlin		0.00	1029.00	60.00	61740.00	67.91	0.00
		Marlins	**0.00**		**1727.00**	**230.00**	**340940.00**	**375.03**	**0.00**
Ariopsis felis	LC	Catfish	7688.11	6.07	32649.00	4.50	4841003.27	5325.10	0.01
Bagre marinus	LC	Catfish	1727.70	1.36	7337.00	4.00	1087887.56	1196.68	0.00
		Catfish	**9415.81**		**39986.00**	**4.25**	**5928890.84**	**6521.78**	**0.01**
Merluccius albidus	LC	Deep Water Fish	0.05	0.00	137.00		28.34	0.03	0.00
Evoxymetopon taeniatus	LC	Deep Water Fish	0.09	0.00	4.00	1.50	58.56	0.06	0.00
Serranus phoebe	LC	Deep Water Fish	0.10	0.00	19.00		64.23	0.07	0.00
Serranus tortugarum	LC	Deep Water Fish	0.12	0.00	416.00		74.93	0.08	0.00
Pronotogrammus martinicensis	LC	Deep Water Fish	0.42	0.00	24.00		262.57	0.29	0.00
Anthias nicholsi	LC	Deep Water Fish	0.47	0.00	7.00		296.58	0.33	0.00
Trichiurus lepturus	LC	Deep Water Fish	1.34	0.00	3555.00	4.50	845.02	0.93	0.00
Physiculus fulvus	LC	Deep Water Fish	2.20	0.00	22.00		1386.54	1.53	0.00
Ariomma regulus	LC	Deep Water Fish	23.43	0.02	9.00		14750.75	16.23	0.00
Hemanthias leptus	LC	Deep Water Fish	23.84	0.02	28.00		15010.80	16.51	0.00
Serranus atrobranchus	LC	Deep Water Fish	25.93	0.02	37.00		16327.45	17.96	0.00
Urophycis regia	LC	Deep Water Fish	31.14	0.02	45.00		19608.69	21.57	0.00
Centropristis philadelphica	LC	Deep Water Fish	92.00	0.07	806.00		57932.55	63.73	0.00

Urophycis floridana	LC	Deep Water Fish	201.89	0.16	2299.00		127124.30	139.84	0.00
Serranus notospilus	LC	Deep Water Fish	251.20	0.20	29.00		158174.17	173.99	0.00
Carapus bermudensis	LC	Deep Water Fish	652.26	0.52	22.00		410713.21	451.78	0.00
Ariomma bondi	LC	Deep Water Fish	702.71	0.56	22.00		442476.50	486.72	0.00
Urophycis earllii	LC	Deep Water Fish	2794.62	2.21	5.00		1759699.61	1935.67	0.00
Baldwinella aureorubens	LC	Deep Water Fish	0.64	0.00	1.00		404.07	0.44	0.00
Anthias woodsi	LC	Deep Water Fish	2.57	0.00	4.00		1616.26	1.78	0.00
Plectranthias garrupellus	LC	Deep Water Fish	4.49	0.00	7.00		2828.46	3.11	0.00
Regalecus glesne	LC	Deep Water Fish	5.13	0.00	8.00	265.00	3232.52	3.56	0.00
Choranthias tenuis	LC	Deep Water Fish	5.13	0.00	8.00		3232.52	3.56	0.00
Echiodon dawsoni	LC	Deep Water Fish	12.83	0.01	20.00		8081.31	8.89	0.00
Baldwinella vivanus	LC	Deep Water Fish		0.00			0.00	0.00	0.00
Centropristis fuscula	LC	Deep Water Fish		0.00			0.00	0.00	0.00
		Deep Water Fish	**4834.61**		**7534.00**	**90.33**	**3044229.95**	**3348.65**	**0.00**
Eucinostomus argenteus	LC	Estuarine Fish	0.00	0.00	8569.00	0.02	1.26	0.00	0.00
Hippocampus zosterae	DD	Estuarine Fish	0.00	0.00	765.00		1.89	0.00	0.00
Syngnathus floridae	LC	Estuarine Fish	0.01	0.00	148.00		3.15	0.00	0.00
Hippocampus reidi	DD	Estuarine Fish	0.02	0.00	6.00		11.33	0.01	0.00
Syngnathus louisianae	DD	Estuarine Fish	0.04	0.00	470.00		24.56	0.03	0.00
Eucinostomus harengulus	LC	Estuarine Fish	0.05	0.00	11.00		28.34	0.03	0.00
Eucinostomus melanopterus	LC	Estuarine Fish	0.07	0.00	262.00	0.03	44.08	0.05	0.00
Diplodus holbrookii	LC	Estuarine Fish	0.10	0.00	65.00		59.82	0.07	0.00
Syngnathus scovelli	LC	Estuarine Fish	0.15	0.00	1372.00		96.34	0.11	0.00
Albula vulpes	NT	Estuarine Fish	0.20	0.00	8.00	9.00	126.56	0.14	0.00
Archosargus rhomboidalis	LC	Estuarine Fish	0.22	0.00	62.00	0.50	138.53	0.15	0.00
Eucinostomus jonesii	LC	Estuarine Fish	0.24	0.00	10.00	0.02	151.75	0.17	0.00
Cyprinodon variegatus	LC	Estuarine Fish	0.35	0.00	4664.00		222.28	0.24	0.00
Hippocampus erectus	VU	Estuarine Fish	1.03	0.00	163.00		647.93	0.71	0.00
Gerres cinereus	LC	Estuarine Fish	2.80	0.00	294.00	0.50	1763.09	1.94	0.00
Eucinostomus gula	LC	Estuarine Fish	113.31	0.09	1194.00		71350.28	78.49	0.00
Calamus arctifrons	LC	Estuarine Fish	211.21	0.17	7.00		132992.24	146.29	0.00
Eugerres brasilianus	LC	Estuarine Fish	0.02	0.00	1.00		11.49	0.01	0.00
Syngnathus makaxi	DD	Estuarine Fish	0.02	0.00	1.00		11.49	0.01	0.00
Bryx dunckeri	LC	Estuarine Fish	0.04	0.00	2.00		22.98	0.03	0.00
Gambusia rhizophorae	LC	Estuarine Fish	0.04	0.00	2.00		22.98	0.03	0.00
Cosmocampus brachycephalus	LC	Estuarine Fish	0.05	0.00	3.00		34.48	0.04	0.00
Diapterus rhombeus	LC	Estuarine Fish	0.07	0.00	4.00	0.07	45.97	0.05	0.00

Diapterus auratus	LC	Estuarine Fish	0.07	0.00	4.00	0.64	45.97	0.05	0.00
Anarchopterus tectus	LC	Estuarine Fish	0.11	0.00	6.00		68.95	0.08	0.00
Eugerres plumieri	LC	Estuarine Fish	0.15	0.00	8.00	0.95	91.94	0.10	0.00
Cosmocampus elucens	LC	Estuarine Fish	0.18	0.00	10.00		114.92	0.13	0.00
Cosmocampus hildebrandi	LC	Estuarine Fish	0.27	0.00	15.00		172.38	0.19	0.00
Macroramphosus scolopax	LC	Estuarine Fish	0.35	0.00	19.00		218.35	0.24	0.00
Eucinostomus havana	LC	Estuarine Fish	1.13	0.00	62.00		712.51	0.78	0.00
Anarchopterus criniger	LC	Estuarine Fish	7.96	0.01	436.00		5010.58	5.51	0.00
Floridichthys carpio	LC	Estuarine Fish	12.01	0.01	658.00		7561.84	8.32	0.00
Eugerres awlae	LC	Estuarine Fish		0.00		0.95			
Cyprinodon artifrons	LC	Estuarine Fish		0.00					
Eucinostomus lefroyi	LC	Estuarine Fish		0.00					
Floridichthys polyommus	LC	Estuarine Fish		0.00					
Microphis brachyurus ssp. lineatus	DD	Estuarine Fish		0.00					
Syngnathus caribbaeus	LC	Estuarine Fish		0.00					
		Estuarine Fish	**352.26**		**19301.00**	**1.27**	**221810.27**	**243.99**	**0.00**
Engyophrys senta	LC	Flatfish	0.00	0.00	37.00		0.63	0.00	0.00
Cyclopsetta fimbriata	LC	Flatfish	0.01	0.00	35.00		3.78	0.00	0.00
Citharichthys cornutus	LC	Flatfish	0.02	0.00	32.00		11.96	0.01	0.00
Citharichthys arctifrons	LC	Flatfish	0.02	0.00	20.00		15.11	0.02	0.00
Symphurus diomedeanus	LC	Flatfish	0.05	0.00	56.00		32.74	0.04	0.00
Symphurus plagiusa	LC	Flatfish	0.05	0.00	11579.00		32.74	0.04	0.00
Gymnachirus melas	LC	Flatfish	0.07	0.00	10.00		40.93	0.05	0.00
Monolene sessilicauda	LC	Flatfish	0.11	0.00	29.00		66.75	0.07	0.00
Symphurus pelicanus	LC	Flatfish	0.12	0.00	14.00		74.30	0.08	0.00
Symphurus urospilus	LC	Flatfish	0.15	0.00	22.00		93.19	0.10	0.00
Paralichthys squamilentus	LC	Flatfish	0.15	0.00	53.00		94.45	0.10	0.00
Trichopsetta ventralis	LC	Flatfish	0.20	0.00	116.00		125.93	0.14	0.00
Paralichthys albigutta	LC	Flatfish	0.23	0.00	363.00	2.60	142.94	0.16	0.00
Citharichthys spilopterus	LC	Flatfish	0.26	0.00	11588.00	0.09	162.46	0.18	0.00
Gymnachirus texae	LC	Flatfish	0.27	0.00	37.00		171.27	0.19	0.00
Etropus rimosus	LC	Flatfish	0.41	0.00	18.00		258.17	0.28	0.00
Symphurus minor	LC	Flatfish	0.44	0.00	16.00		276.43	0.30	0.00
Citharichthys dinoceros	LC	Flatfish	0.57	0.00	9.00		356.40	0.39	0.00
Symphurus parvus	LC	Flatfish	1.09	0.00	99.00		684.46	0.75	0.00
Bothus lunatus	LC	Flatfish	1.70	0.00	5.00		1071.71	1.18	0.00
Cyclopsetta chittendeni	LC	Flatfish	2.25	0.00	69.00	0.07	1414.88	1.56	0.00

Paralichthys lethostigma	NT	Flatfish	2.40	0.00	6092.00	9.00	1509.96	1.66	0.00
Citharichthys arenaceus	LC	Flatfish	4.65	0.00	1.00		2930.50	3.22	0.00
Etropus cyclosquamus	LC	Flatfish	7.19	0.01	3.00		4529.25	4.98	0.00
Bothus ocellatus	LC	Flatfish	7.83	0.01	268.00		4929.72	5.42	0.00
Achirus lineatus	LC	Flatfish	9.27	0.01	496.00	0.02	5837.71	6.42	0.00
Symphurus pusillus	LC	Flatfish	25.74	0.02	4.00		16208.44	17.83	0.00
Etropus crossotus	LC	Flatfish	56.22	0.04	10397.00		35399.66	38.94	0.00
Syacium gunteri	LC	Flatfish	68.32	0.05	212.00		43019.34	47.32	0.00
Symphurus civitatium	LC	Flatfish	145.68	0.12	62.00		91732.83	100.91	0.00
Symphurus arawak	LC	Flatfish	151.81	0.12			95588.33	105.15	0.00
Gymnachirus nudus	LC	Flatfish	223.91	0.18	1.00		140990.36	155.09	0.00
Bothus robinsi	LC	Flatfish	236.29	0.19	30.00		148787.62	163.67	0.00
Citharichthys gymnorhinus	LC	Flatfish	246.43	0.19	13.00		155171.25	170.69	0.00
Ancylopsetta dilecta	LC	Flatfish	390.53	0.31	73.00		245903.53	270.49	0.00
Symphurus piger	LC	Flatfish	763.62	0.60	9.00		480834.37	528.92	0.00
Syacium papillosum	LC	Flatfish	1055.43	0.83	167.00		664575.83	731.03	0.00
Citharichthys macrops	LC	Flatfish	1148.19	0.91	197.00		722983.15	795.28	0.00
Syacium micrurum	LC	Flatfish	7010.98	5.54	35.00	0.45	4414634.16	4856.10	0.01
Bothus maculiferus	LC	Flatfish	0.27	0.00	1.00		169.99	0.19	0.00
Citharichthys abbotti	LC	Flatfish	0.27	0.00	1.00		169.99	0.19	0.00
Symphurus caribbeanus	LC	Flatfish	0.27	0.00	1.00		169.99	0.19	0.00
Symphurus tessellatus	LC	Flatfish	0.27	0.00	1.00		169.99	0.19	0.00
Gastropsetta frontalis	LC	Flatfish	6.21	0.00	23.00		3909.85	4.30	0.00
Ancylopsetta ommata	LC	Flatfish	12.96	0.01	48.00		8159.68	8.98	0.00
Paralichthys oblongus	LC	Flatfish		0.00					
		Flatfish	**11582.89**		**42342.00**	**2.04**	**7293446.74**	**8022.79**	**0.01**
Mycteroperca microlepis	LC	Gag Grouper	222.34	0.18	222.00	37.00	140001.14	154.00	0.00
		Gag Grouper	**222.34**		**222.00**	**37.00**	**140001.14**	**154.00**	**0.00**
Seriola dumerili	LC	Greater Amberjack	12.49	0.01	538.00	78.00	7862.74	8.65	0.01
		Greater Amberjack	**12.49**		**538.00**	**78.00**	**7862.74**	**8.65**	**0.01**
Mycteroperca phenax	LC	Groupers	0.01	0.00	1611.00	13.80	6.30	0.01	0.00
Hyporthodus niveatus	VU	Groupers	0.02	0.00	27.00	27.00	12.59	0.01	0.00
Gonioplectrus hispanus	LC	Groupers	0.04	0.00	21.00		22.04	0.02	0.00
Hyporthodus flavolimbatus	VU	Groupers	0.06	0.00	24.00	17.00	37.15	0.04	0.00
Mycteroperca venenosa	NT	Groupers	0.06	0.00	218.00	18.00	37.78	0.04	0.00
Cephalopholis cruentata	LC	Groupers	0.10	0.00	8169.00	1.00	62.97	0.07	0.00
Epinephelus drummondhayi	CR	Groupers	0.46	0.00	13.00	28.00	289.65	0.32	0.00
Mycteroperca	NT	Groupers	8.50	0.01	4523.00	90.00	5354.12	5.89	0.00

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Paranthias furcifer	LC	Groupers	53.08	0.04	82.00		33423.11	36.77	0.00
Mycteroperca interstitialis	VU	Groupers	113.63	0.09	402.00	9.80	71548.63	78.70	0.00
Epinephelus guttatus	LC	Groupers	561.87	0.44	473.00	23.50	353795.07	389.17	0.00
Epinephelus itajara	CR	Groupers	1274.56	1.01	296.00	440.00	802558.23	882.81	0.00
Mycteroperca acutirostris	LC	Groupers	0.76	0.00	6.00	8.50	479.41	0.53	0.00
Alphestes afer	LC	Groupers	1.40	0.00	11.00		878.91	0.97	0.00
Hyporthodus mystacinus	LC	Groupers	1.78	0.00	14.00	100.00	1118.61	1.23	0.00
Hyporthodus nigritus	CR	Groupers	2.41	0.00	19.00	185.00	1518.12	1.67	0.00
Dermatolepis inermis	NT	Groupers	2.54	0.00	20.00	9.50	1598.02	1.76	0.00
Mycteroperca tigris	LC	Groupers	16.24	0.01	128.00	9.60	10227.31	11.25	0.00
Epinephelus striatus	EN	Groupers	30.96	0.02	244.00	23.00	19495.81	21.45	0.00
		Groupers	**2068.47**		**16301.00**	**62.73**	**1302463.81**	**1432.71**	**0.00**
Hemicaranx amblyrhynchus	LC	Jacks	0.00	0.00	79.00		0.63	0.00	0.00
Decapterus tabl	LC	Jacks	0.00	0.00	3.00	0.53	1.26	0.00	0.00
Chloroscombrus chrysurus	LC	Jacks	0.01	0.00	8871.00	29.00	3.78	0.00	0.00
Selar crumenophthalmus	LC	Jacks	0.01	0.00	33.00		4.41	0.00	0.00
Seriola zonata	LC	Jack	0.01	0.00	15.00	5.00	7.56	0.01	0.00
Oligoplites saurus ssp. saurus	LC	Jacks	0.04	0.00		0.24	27.71	0.03	0.00
Caranx ruber	LC	Jack	0.05	0.00	12976.00	8.00	32.11	0.04	0.00
Selene vomer	LC	Jacks	0.07	0.00	662.00	1.95	45.34	0.05	0.00
Decapterus punctatus	LC	Jacks	0.11	0.00	307.00	0.27	69.89	0.08	0.00
Caranx hippos	LC	Jack	0.26	0.00	536.00	30.00	160.57	0.18	0.00
Caranx latus	LC	Jack	0.32	0.00	170.00	12.70	202.13	0.22	0.00
Uraspis secunda	LC	Jack	0.39	0.00	11.00	1.80	244.31	0.27	0.00
Seriola rivoliana	LC	Jack	3.39	0.00	251.00	56.00	2131.45	2.34	0.00
Caranx bartholomaei	LC	Jack	13.68	0.01		13.50	8613.94	9.48	0.00
Seriola fasciata	LC	Jack	25.27	0.02	19.00	4.30	15912.50	17.50	0.00
Caranx crysos	LC	Jack	185.65	0.15	1005.00	4.90	116897.13	128.59	0.00
Selene setapinnis	LC	Jacks	187.89	0.15	1620.00	4.30	118310.12	130.14	0.00
Decapterus macarellus	LC	Jacks	1292.04	1.02	172.00		813561.16	894.92	0.00
Selene brownii	LC	Jacks	0.06	0.00	1.00	0.12	39.94	0.04	0.00
Naucrates ductor	LC	Jacks	0.19	0.00	3.00		119.82	0.13	0.00
Caranx lugubris	LC	Jack	0.76	0.00	12.00	16.50	479.27	0.53	0.00
Elagatis bipinnulata	LC	Jacks	8.94	0.01	141.00	40.00	5631.48	6.19	0.00
		Jacks	**1719.14**		**26887.00**	**12.73**	**1082496.51**	**1190.75**	**0.00**
Scomberomorus cavalla	LC	King Mackerel	0.74	0.00	384.00	7.50	2880.00	3.17	0.00
		King Mackerel	**0.74**		**384.00**	**7.50**	**2880.00**	**3.17**	**0.00**
Elops saurus	LC	Ladyfish	0.17	0.00	3713.00	9.80	36387.40	40.03	0.00

Elops smithi	DD	Ladyfish		0.00					
		Ladyfish	**0.17**		**3713.00**	**9.80**	**36387.40**	**40.03**	**0.00**
Sarda sarda	LC	Large Pelagic Fish	0.00	0.00	433.00	9.00	0.63	0.00	0.00
Megalops atlanticus	VU	Large Pelagic Fish	0.00	0.00	335.00	155.00	1.89	0.00	0.00
Euthynnus alletteratus	LC	Little Tunny	0.22	0.00	184.00	16.00	136.01	0.15	0.00
Coryphaena hippurus	LC	Large Pelagic Fish	99.19	0.08	20752.00	38.00	62458.02	68.70	0.00
Ranzania laevis	LC	Large Pelagic Fish	0.00	0.00	1.00		2.88	0.00	0.00
Luvarus imperialis	LC	Large Pelagic Fish	0.04	0.00	8.00	142.00	23.07	0.03	0.00
Coryphaena equiselis	LC	Large Pelagic Fish	0.14	0.00	30.00		86.52	0.10	0.00
Mola mola	VU	Large Pelagic Fish	0.18	0.00	40.00	700.00	115.36	0.13	0.00
Lampris guttatus	LC	Large Pelagic Fish	0.19	0.00	41.00	255.00	118.25	0.13	0.00
Masturus lanceolatus	LC	Large Pelagic Fish	0.19	0.00	42.00	1700.00	121.13	0.13	0.00
Acanthocybium solandri	LC	Large Pelagic Fish	85.64	0.07	18698.00	80.00	53926.94	59.32	0.00
		Large Pelagic Fish	**185.80**		**40564.00**	**343.89**	**116990.71**	**128.69**	**0.00**
Sphyraena barracuda	LC	Large Reef Fish	40.35	0.03	3244.00	42.00	136248.00	149.87	0.00
Sphyraena borealis	LC	Large Reef Fish	878.62	0.69	22.00	0.80	553244.38	608.57	0.00
Sphyraena guachancho	LC	Large Reef Fish	0.66	0.00	2112.00	1.50	3168.00	3.48	0.00
		Large Reef Fish	**919.63**		**5378.00**	**14.77**	**692660.38**	**761.93**	**0.00**
Pristipomoides aquilonaris	LC	Lutjanidae	0.01	0.00	105.00	1.60	3.78	0.00	0.00
Etelis oculatus	DD	Lutjanidae	0.01	0.00	25.00	4.30	4.41	0.00	0.00
Lutjanus vivanus	LC	Lutjanidae	0.05	0.00	9.00		28.34	0.03	0.00
Lutjanus analis	NT	Lutjanidae	0.21	0.00	3723.00	14.70	134.75	0.15	0.00
Lutjanus apodus	LC	Lutjanidae	0.43	0.00	6326.00	9.90	268.24	0.30	0.00
Lutjanus griseus	LC	Lutjanidae	0.54	0.00	15065.00	18.00	342.54	0.38	0.00
Apsilus dentatus	LC	Lutjanidae	0.90	0.00	7.00	2.90	566.08	0.62	0.00
Lutjanus synagris	NT	Lutjanidae	2.00	0.00	2996.00	3.10	1259.98	1.39	0.00
Rhomboplites aurorubens	VU	Lutjanidae	2.90	0.00	46.00	2.90	1826.06	2.01	0.00
Ocyurus chrysurus	DD	Lutjanidae	6.50	0.01	46041.00	3.70	4092.88	4.50	0.00
Lutjanus buccanella	DD	Lutjanidae	10295.14	8.13	110.00	12.40	6482587.02	7130.85	0.01
Pristipomoides macrophthalmus	LC	Lutjanidae	0.69	0.00	5.00		435.92	0.48	0.00
Lutjanus cyanopterus	VU	Lutjanidae	10.80	0.01	78.00	50.00	6800.36	7.48	0.00
Lutjanus jocu	DD	Lutjanidae	55.66	0.04	402.00	27.00	35047.99	38.55	0.00
Lutjanus mahogoni	LC	Lutjanidae	154.24	0.12	1114.00	1.00	97123.03	106.84	0.00
		Lutjanidae	**10530.08**		**76052.00**	**11.65**	**6630521.36**	**7293.57**	**0.01**
Trachurus lathami	LC	Mackerel	0.02	0.00	187.00	0.45	15.11	0.02	0.00
Scomberomorus regalis	LC	Mackerel	0.20	0.00	1653.00	7.50	124.68	0.14	0.00
Scomber colias	LC	Mackerel	1400.37	1.11	12.00		881776.29	969.95	0.00
		Mackerel	**1400.59**		**1852.00**	**3.98**	**881916.08**	**970.11**	**0.00**

Brevoortia gunteri	LC	Menehaden	2919.19	2.31	471.00		1838140.65	2021.95	0.00
Brevoortia patronus	LC	Menehaden	0.08	0.00	25551.00	0.35	8942.85	9.84	0.00
Brevoortia smithi	LC	Menehaden	0.45	0.00	33.00		284.61	0.31	0.00
		Menehaden	**2919.73**		**26055.00**	**0.35**	**1847368.11**	**2032.10**	**0.00**
Lepophidium staurophor	LC	Eels	0.00	0.00	4.00		1.26	0.00	0.00
Muraena retifera	LC	Eels	0.00	0.00	22.00		1.26	0.00	0.00
Lepophidium profundorum	LC	Eels	0.00	0.00	10.00		2.52	0.00	0.00
Conger triporiceps	LC	Eels	0.01	0.00	4.00		3.78	0.00	0.00
Ophichthus rex	LC	Eels	0.01	0.00	26.00	22.50	7.56	0.01	0.00
Hoplunnis tenuis	LC	Eels	0.01	0.00	18.00		8.19	0.01	0.00
Saurenchelys cognita	LC	Eels	0.02	0.00	9.00		12.59	0.01	0.00
Myrichthys ocellatus	LC	Eels	0.04	0.00	8.00		25.19	0.03	0.00
Ophichthus gomesii	LC	Eels	0.04	0.00	201.00		25.82	0.03	0.00
Dysomma anguillare	LC	Eels	0.05	0.00	6.00		28.34	0.03	0.00
Rhynchoconger gracilior	LC	Eels	0.06	0.00	18.00		35.89	0.04	0.00
Myrophis punctatus	LC	Eels	0.06	0.00	1405.00		37.15	0.04	0.00
Uroconger syringinus	LC	Eels	0.09	0.00	21.00		57.30	0.06	0.00
Bascanichthys bascanium	LC	Eels	0.15	0.00	9.00		91.93	0.10	0.00
Brotula barbata	LC	Eels	0.19	0.00	44.00	8.00	117.75	0.13	0.00
Otophidium omostigma	LC	Eels	0.35	0.00	7.00		221.65	0.24	0.00
Pseudomyrophis fugesae	LC	Eels	0.39	0.00			246.20	0.27	0.00
Echiophis punctifer	LC	Eels	0.45	0.00	24.00		285.87	0.31	0.00
Conger oceanicus	LC	Eels	0.46	0.00	16.00	38.00	287.13	0.32	0.00
Neobythites gilli	LC	Eels	0.64	0.00	36.00		402.99	0.44	0.00
Paraconger caudilimbatus	LC	Eels	1.16	0.00	17.00		732.94	0.81	0.00
Aplatophis chauliodus	LC	Eels	1.43	0.00	10.00		901.06	0.99	0.00
Neobythites marginatus	LC	Eels	1.55	0.00	35.00		978.51	1.08	0.00
Gymnothorax saxicola	LC	Eels	1.56	0.00	71.00		984.18	1.08	0.00
Echiophis intertinctus	LC	Eels	1.60	0.00	12.00		1007.48	1.11	0.00
Rhynchoconger flavus	LC	Eels	1.71	0.00	49.00		1078.00	1.19	0.00
Ariosoma balearicum	LC	Eels	2.79	0.00	27.00		1755.53	1.93	0.00
Ophidion holbrookii	LC	Eels	3.11	0.00	16.00		1958.29	2.15	0.00
Otophidium dormitator	LC	Eels	5.91	0.00			3719.49	4.09	0.00
Myrophis platyrhynchus	LC	Eels	9.28	0.01	1.00		5842.75	6.43	0.00
Hoplunnis macrura	LC	Eels	11.09	0.01	43.00		6980.57	7.68	0.00
Gymnothorax kolpos	LC	Eels	14.69	0.01	26.00	0.90	9248.03	10.17	0.00
Ophichthus ophis	LC	Eels	16.74	0.01	6.00		10537.60	11.59	0.00
Hoplunnis diomediana	LC	Eels	22.25	0.02	27.00		14012.77	15.41	0.00

Gymnothorax vicinus	LC	Eels	23.18	0.02	22.00	0.67	14595.85	16.06	0.00
Gymnothorax funebris	LC	Eels	25.32	0.02	178.00	27.00	15942.09	17.54	0.00
Ophichthus melanoporus	LC	Eels	37.79	0.03	12.00		23796.02	26.18	0.00
Gymnothorax nigromarginatus	LC	Eels	39.06	0.03	65.00	1.20	24596.97	27.06	0.00
Ophidion antipholus	LC	Eels	73.54	0.06	2.00		46308.76	50.94	0.00
Neoconger mucronatus	LC	Eels	86.45	0.07	59.00		54437.86	59.88	0.00
Gymnothorax moringa	LC	Eels	186.72	0.15	333.00	2.10	117569.63	129.33	0.00
Lepophidium jeannae	LC	Eels	231.98	0.18			146071.20	160.68	0.00
Ophichthus puncticeps	LC	Eels	292.18	0.23	31.00		183980.11	202.38	0.00
Ophidion selenops	LC	Eels	407.35	0.32	4.00		256499.69	282.15	0.00
Lepophidium brevibarbe	LC	Eels	661.34	0.52	65.00		416429.39	458.07	0.00
Ophidion grayi	LC	Eels	807.63	0.64	12.00		508540.66	559.39	0.00
Lepophidium marmoratum	LC	Eels	0.00	0.00	0.00		0.00	0.00	0.00
Ophichthus spinicauda	LC	Eels	0.00	0.00	0.00		0.00	0.00	0.00
Chlopsis dentatus	DD	Eels	0.00	0.00	0.00		0.00	0.00	0.00
Gymnothorax maderensis	LC	Eels	0.00	0.00	0.00		0.00	0.00	0.00
Gymnothorax polygonius	LC	Eels	0.00	0.00	0.00		0.00	0.00	0.00
Aprognathodon platyventris	LC	Eels	0.91	0.00	1.00		571.36	0.63	0.00
Apterichtus ansp	LC	Eels	0.91	0.00	1.00		571.36	0.63	0.00
Caralophia loxochila	LC	Eels	0.91	0.00	1.00		571.36	0.63	0.00
Ichthyapus ophioneus	LC	Eels	0.91	0.00	1.00		571.36	0.63	0.00
Lepophidium crossotum	LC	Eels	0.91	0.00	1.00		571.36	0.63	0.00
Lepophidium entomelan	LC	Eels	0.91	0.00	1.00		571.36	0.63	0.00
Lepophidium pheromystax	LC	Eels	0.91	0.00	1.00		571.36	0.63	0.00
Ophidion dromio	LC	Eels	0.91	0.00	1.00		571.36	0.63	0.00
Channomuraena vittata	LC	Eels	0.91	0.00	1.00		571.36	0.63	0.00
Echidna catenata	LC	Eels	0.91	0.00	1.00		571.36	0.63	0.00
Gordiichthys irretitus	LC	Eels	1.81	0.00	2.00		1142.72	1.26	0.00
Gymnothorax hubbsi	LC	Eels	1.81	0.00	2.00		1142.72	1.26	0.00
Monopenchelys acuta	LC	Eels	1.81	0.00	2.00		1142.72	1.26	0.00
Uropterygius macularius	LC	Eels	1.81	0.00	2.00		1142.72	1.26	0.00
Heteroconger luteolus	LC	Eels	2.72	0.00	3.00		1714.08	1.89	0.00
Gordiichthys ergodes	DD	Eels	3.63	0.00	4.00		2285.45	2.51	0.00
Callechelys guineensis	LC	Eels	4.54	0.00	5.00		2856.81	3.14	0.00
Gordiichthys leibyi	LC	Eels	4.54	0.00	5.00		2856.81	3.14	0.00
Apterichtus kendalli	LC	Eels	5.44	0.00	6.00		3428.17	3.77	0.00
Ariosoma anale	LC	Eels	5.44	0.00	6.00		3428.17	3.77	0.00

Nettenchelys pygmaea	LC	Eels	5.44	0.00	6.00		3428.17	3.77	0.00
Anarchias similis	LC	Eels	5.44	0.00	6.00		3428.17	3.77	0.00
Ethadophis akkistikos	LC	Eels	6.35	0.01	7.00		3999.53	4.40	0.00
Moringua edwardsi	LC	Eels	6.35	0.01	7.00		3999.53	4.40	0.00
Myrichthys breviceps	LC	Eels	6.35	0.01	7.00		3999.53	4.40	0.00
Enchelycore carychroa	LC	Eels	6.35	0.01	7.00		3999.53	4.40	0.00
Kaupichthys nuchalis	LC	Eels	6.35	0.01	7.00		3999.53	4.40	0.00
Enchelycore nigricans	LC	Eels	7.26	0.01	8.00	1.10	4570.89	5.03	0.00
Ophichthus hyposagmatus	LC	Eels	7.26	0.01	8.00		4570.89	5.03	0.00
Bascanichthys scuticaris	LC	Eels	8.17	0.01	9.00		5142.25	5.66	0.00
Callechelys muraena	LC	Eels	8.17	0.01	9.00		5142.25	5.66	0.00
Ahlia egmontis	LC	Eels	9.07	0.01	10.00		5713.61	6.28	0.00
Gnathophis bracheatopos	LC	Eels	9.07	0.01	10.00		5713.61	6.28	0.00
Letharchus velifer	LC	Eels	9.98	0.01	11.00		6284.97	6.91	0.00
Ophidion josephi	LC	Eels	10.89	0.01	12.00		6856.34	7.54	0.00
Heteroconger longissimus	LC	Eels	15.43	0.01	17.00		9713.14	10.68	0.00
Gymnothorax miliaris	LC	Eels	65.33	0.05	72.00		41138.01	45.25	0.00
Callechelys bilinearis	LC	Eels		0.00					
Gordiichthys randalli	LC	Eels		0.00					
Lepophidium gilmorei	LC	Eels		0.00					
Parophidion schmidti	LC	Eels		0.00					
Petrotyx sanguineus	LC	Eels		0.00					
Quassiremus ascensionis	LC	Eels		0.00					
Chilorhinus suensonii	LC	Eels		0.00					
Chlopsis bicolor	LC	Eels		0.00					
Kaupichthys hyoproroides	LC	Eels		0.00					
		Eels	**3206.36**		**3271.00**	**11.27**	**110844.09**	**121.93**	**0.00**
Mugil curema	LC	Mullets	0.15	0.00	2798.00	0.61	92.56	0.10	0.00
Mugil cephalus	LC	Mullets	4.28	0.00	11047.00	21.34	2696.27	2.97	0.00
Mugil liza	DD	Mullets	0.00	0.00	4.00	8.20	0.81	0.00	0.00
Mugil trichodon	LC	Mullets	0.00	0.00	13.00	0.17	2.62	0.00	0.00
Mugil rubrioculus	LC	Mullets		0.00					
		Mullets	**4.43**		**13862.00**	**7.58**	**2792.25**	**3.07**	**0.00**
Tetrapturus pfluegeri	LC	Other Billfish	0.12	0.00	51.00	52.00	77.45	0.09	0.00
Tetrapturus georgii	DD	Other Billfish	0.02	0.00	9.00	18.50	13.67	0.02	0.00
Istiophorus platypterus	LC	Other Billfish	0.02	0.00	10.00	90.00	15.19	0.02	0.00
		Other Billfish	**0.17**		**70.00**	**53.50**	**106.30**	**0.12**	**0.00**
Zalieutes mcgintyi	LC	Other Demersal Fish	0.03	0.00	20.00		18.26	0.02	0.00

Lophiodes reticulatus	LC	Other Demersal Fish	0.10	0.00	23.00		62.97	0.07	0.00
Lophius gastrophysus	LC	Other Demersal Fish	0.20	0.00	65.00		128.45	0.14	0.00
Kathetostoma albigutta	LC	Other Demersal Fish	0.45	0.00	54.00		282.09	0.31	0.00
Ogcocephalus parvus	LC	Other Demersal Fish	0.78	0.00	33.00	0.01	490.52	0.54	0.00
Opsanus beta	LC	Other Demersal Fish	0.81	0.00	2876.00		509.41	0.56	0.00
Ogcocephalus rostellum	LC	Other Demersal Fish	0.93	0.00			583.71	0.64	0.00
Halieutichthys aculeatus	LC	Other Demersal Fish	1.99	0.00	91.00		1254.31	1.38	0.00
Opsanus pardus	LC	Other Demersal Fish	4.42	0.00	21.00		2783.16	3.06	0.00
Ogcocephalus declivirostris	LC	Other Demersal Fish	15.57	0.01	69.00		9804.03	10.78	0.00
Ogcocephalus pantostictus	LC	Other Demersal Fish	52.75	0.04	20.00		33216.58	36.54	0.00
Ogcocephalus corniger	LC	Other Demersal Fish	77.82	0.06	26.00		49001.25	53.90	0.00
Ogcocephalus cubifrons	LC	Other Demersal Fish	159.82	0.13	18.00		100633.91	110.70	0.00
Ogcocephalus nasutus	LC	Other Demersal Fish	177.04	0.14	14.00		111479.42	122.63	0.00
Opsanus tau	LC	Other Demersal Fish	218.55	0.17	4.00	2.00	137615.94	151.38	0.00
Porichthys plectrodon	LC	Other Demersal Fish	66530.29	52.56	123.00	10.30	41892406.94	46081.65	0.06
Dactyloscopus tridigitatus	LC	Other Demersal Fish	19.45	0.02	1.00		12247.69	13.47	0.00
Gillellus uranidea	LC	Other Demersal Fish	19.45	0.02	1.00		12247.69	13.47	0.00
Opsanus dichrostomus	LC	Other Demersal Fish	19.45	0.02	1.00		12247.69	13.47	0.00
Platygillellus rubrocinctus	LC	Other Demersal Fish	19.45	0.02	1.00		12247.69	13.47	0.00
Sanopus reticulatus	EN	Other Demersal Fish	19.45	0.02	1.00		12247.69	13.47	0.00
Gillellus greyae	LC	Other Demersal Fish	116.71	0.09	6.00		73486.15	80.83	0.00
Dactyloscopus moorei	LC	Other Demersal Fish	291.76	0.23	15.00		183715.38	202.09	0.00
Gillellus healae	LC	Other Demersal Fish	291.76	0.23	15.00		183715.38	202.09	0.00
Xenocephalus egregius	LC	Other Demersal Fish	602.98	0.48	31.00		379678.45	417.65	0.00
Astroscopus y-graecum	LC	Other Demersal Fish	1731.12	1.37	89.00		1090044.58	1199.05	0.00
Dactyloscopus crossotus	LC	Other Demersal Fish		0.00					
Dactyloscopus foraminosus	LC	Other Demersal Fish		0.00					
Dactyloscopus poeyi	LC	Other Demersal Fish		0.00					
Halieutichthys bispinosus	LC	Other Demersal Fish		0.00					
Halieutichthys intermedius	LC	Other Demersal Fish		0.00					
Opsanus phobetron	LC	Other Demersal Fish		0.00					
		Other Demersal Fish	**70373.13**		**3618.00**	**4.10**	**44312149.33**	**48743.36**	**0.06**
Auxis rochei	LC	Other tuna	1.07	0.00			670.60	0.74	0.00
Thunnus atlanticus	LC	Other Tuna	25.00	0.02	6447.00	18.00	116046.00	127.65	0.00
Thunnus alalunga	NT	Other Tuna	6.91	0.01	1710.00	55.00	94050.00	103.46	0.00
Katsuwonus pelamis	LC	Other Tuna	10.84	0.01	2682.00	31.00	83142.00	91.46	0.00

Thunnus obesus	VU	Other Tuna	20.76	0.02	5133.00	195.00	1000935.00	1101.03	0.00
Auxis thazard	LC	Other Tuna		0.00		1.50			
		Other Tuna	**64.58**		**15972.00**	**60.10**	**1294843.60**	**1424.33**	**0.00**
Lagodon rhomboides	LC	Pinfish	0.05	0.00	40138.00	1.20	48165.60	52.98	0.00
		Pinfish	**0.05**		**40138.00**	**1.20**	**48165.60**	**52.98**	**0.00**
Alectis ciliaris	LC	Pompano	11.22	0.01	48.00	20.00	7061.80	7.77	0.00
Trachinotus carolinus	LC	Pompano	6.02	0.00	279.00	3.40	3788.75	4.17	0.00
Trachinotus falcatus	LC	Pompano	0.16	0.00	328.00	33.00	102.64	0.11	0.00
Trachinotus goodei	LC	Pompano	1151.78	0.91	7.00	0.50	725243.68	797.77	0.00
		Pompano	**1169.17**		**662.00**	**14.23**	**736196.87**	**809.82**	**0.00**
Sciaenops ocellatus	LC	Red Drum 0-3	0.05	0.00	41925.00	0.04	28.34	0.03	0.00
Sciaenops ocellatus	CR	Red Drum 18-36		0.00		3.50			
Sciaenops ocellatus	EN	Red Drum 36+		0.00		8.00			
Sciaenops ocellatus	VU	Red Drum 3-8		0.00		20.00			
Sciaenops ocellatus	NT	Red Drum 8-18		0.00		40.00			
		Red Drum	**0.05**		**41925.00**	**14.31**	**28.34**	**0.03**	**0.00**
Epinephelus morio	VU	Red Grouper 0	43.23	0.03	18441.00	0.07	27220.19	29.94	0.00
Epinephelus morio	NT	Red Grouper 1-3		0.00		2.50			
Epinephelus morio	DD	Red Grouper 3+		0.00		15.00			
		Red Grouper	**43.23**		**18441.00**	**5.86**	**27220.19**	**29.94**	**0.00**
Lutjanus campechanus	VU	Red Snapper	707.68	0.56	478.00	18.00	445605.98	490.17	0.00
		Red Snapper	**707.68**		**478.00**	**18.00**	**445605.98**	**490.17**	**0.00**
Harengula jaguana	LC	Scaled Sardine	0.03	0.00	1770.00		15.74	0.02	0.00
		Scaled Sardine	**0.03**		**1770.00**		**15.74**	**0.02**	**0.00**
Mycteroperca phenax	LC	Scamp Grouper	0.01	0.00	1611.00	11.00	6.30	0.01	0.00
		Scamp Grouper	**0.01**		**1611.00**	**11.00**	**6.30**	**0.01**	**0.00**
Larimus fasciatus	LC	Sciaenidae	0.00	0.00	1303.00		0.63	0.00	0.00
Leiostomus xanthurus	LC	Sciaenidae	0.01	0.00	91487.00		4.41	0.00	0.00
Umbrina coroides	LC	Sciaenidae	0.13	0.00	5.00		79.34	0.09	0.00
Menticirrhus littoralis	LC	Sciaenidae	0.22	0.00	44.00		138.53	0.15	0.00
Equetus lanceolatus	LC	Sciaenidae	0.23	0.00	120.00		142.94	0.16	0.00
Stellifer lanceolatus	LC	Sciaenidae	0.38	0.00	6391.00		236.13	0.26	0.00
Odontoscion dentex	LC	Sciaenidae	0.69	0.00	945.00		431.33	0.47	0.00
Menticirrhus americanus	LC	Sciaenidae	146.00	0.12	2877.00		91933.07	101.13	0.00
Bairdiella chrysoura	LC	Sciaenidae	161.32	0.13	13626.00		101576.53	111.73	0.00
Equetus punctatus	LC	Sciaenidae	364.05	0.29	174.00		229229.76	252.15	0.00
Menticirrhus saxatilis	LC	Sciaenidae	654.00	0.52	76.00		411804.44	452.98	0.00
Bairdiella ronchus	LC	Sciaenidae	0.02	0.00	2.00		14.28	0.02	0.00
Corvula sanctaeluciae	LC	Sciaenidae	0.02	0.00	2.00		14.28	0.02	0.00

Corvula batabana	LC	Sciaenidae	0.06	0.00	5.00		35.69	0.04	0.00
Pareques iwamotoi	LC	Sciaenidae	0.20	0.00	18.00		128.50	0.14	0.00
Pareques umbrosus	LC	Sciaenidae	0.98	0.00	86.00		613.93	0.68	0.00
Pareques acuminatus	LC	Sciaenidae	14.31	0.01	1262.00		9009.11	9.91	0.00
		Sciaenidae	**1342.59**		**118423.00**		**845392.88**	**929.93**	**0.00**
Cynoscion arenarius	LC	Sea Trout	582.32	0.46	28867.00		366673.17	403.34	0.00
Cynoscion nebulosus	LC	Sea Trout	20460.38	16.16	9599.00		12883374.95	14171.71	0.02
Cynoscion nothus	LC	Sea Trout	0.01	0.00			3.78	0.00	0.00
		Sea Trout	**21042.71**		**38466.00**		**13250051.89**	**14575.06**	**0.02**
Liopropoma eukrines	LC	Shallow Serranid	0.00	0.00	19.00		1.89	0.00	0.00
Rypticus maculatus	LC	Shallow Serranid	0.05	0.00	38.00		28.34	0.03	0.00
Rypticus subbifrenatus	LC	Shallow Serranid	0.07	0.00	3.00		46.60	0.05	0.00
Rypticus saponaceus	LC	Shallow Serranid	0.09	0.00	70.00		58.56	0.06	0.00
Serraniculus pumilio	LC	Shallow Serranid	0.32	0.00	73.00		202.13	0.22	0.00
Hypoplectrus puella	LC	Shallow Serranid	0.51	0.00	2650.00		321.13	0.35	0.00
Hypoplectrus nigricans	LC	Shallow Serranid	0.89	0.00	945.00		560.41	0.62	0.00
Hypoplectrus unicolor	LC	Shallow Serranid	2.15	0.00	10932.00		1356.32	1.49	0.00
Serranus subligarius	LC	Shallow Serranid	2.92	0.00	17.00		1835.50	2.02	0.00
Centropristis striata	LC	Shallow Serranid	3.20	0.00	10.00		2014.96	2.22	0.00
Rypticus bistrispinus	LC	Shallow Serranid	30.79	0.02	38.00		19385.78	21.32	0.00
Diplectrum formosum	LC	Shallow Serranid	62.69	0.05	147.00		39474.91	43.42	0.00
Diplectrum bivittatum	LC	Shallow Serranid	2889.58	2.28	30.00		1819494.73	2001.44	0.00
Serranus annularis	LC	Shallow Serranid	4959.39	3.92	17.00		3122800.15	3435.08	0.00
Centropristis ocyurus	LC	Shallow Serranid	11829.40	9.34	41.00		7448669.14	8193.54	0.01
Hypoplectrus ecosur	DD	Shallow Serranid	0.00	0.00	0.00		0.00	0.00	0.00
Rypticus randalli	LC	Shallow Serranid	0.00	0.00	0.00		0.00	0.00	0.00
Serranus luciopercanus	LC	Shallow Serranid	0.00	0.00	0.00		0.00	0.00	0.00
Hypoplectrus aberrans	LC	Shallow Serranid	1.32	0.00	1.00		828.76	0.91	0.00
Liopropoma aberrans	LC	Shallow Serranid	1.32	0.00	1.00		828.76	0.91	0.00
Liopropoma carmabi	LC	Shallow Serranid	1.32	0.00	1.00		828.76	0.91	0.00
Liopropoma mowbrayi	LC	Shallow Serranid	1.32	0.00	1.00		828.76	0.91	0.00
Serranus chionaraia	LC	Shallow Serranid	1.32	0.00	1.00		828.76	0.91	0.00
Diplectrum radiale	LC	Shallow Serranid	7.90	0.01	6.00		4972.56	5.47	0.00
Hypoplectrus gummigutta	LC	Shallow Serranid	7.90	0.01	6.00		4972.56	5.47	0.00
Liopropoma rubre	LC	Shallow Serranid	14.48	0.01	11.00		9116.35	10.03	0.00
Hypoplectrus chlorurus	LC	Shallow Serranid	21.06	0.02	16.00		13260.15	14.59	0.00

Hypoplectrus guttavarius	LC	Shallow Serranid	23.69	0.02	18.00		14917.67	16.41	0.00
Schultzea beta	LC	Shallow Serranid	60.54	0.05	46.00		38122.92	41.94	0.00
Hypoplectrus indigo	LC	Shallow Serranid	136.88	0.11	104.00		86190.96	94.81	0.00
Serranus baldwini	LC	Shallow Serranid	1158.23	0.91	880.00		729308.08	802.24	0.00
Serranus tabacarius	LC	Shallow Serranid	2067.71	1.63	1571.00		1301980.68	1432.18	0.00
Hypoplectrus gemma	LC	Shallow Serranid	4396.01	3.47	3340.00		2768055.67	3044.86	0.00
Serranus tigrinus	LC	Shallow Serranid	6957.28	5.50	5286.00		4380821.05	4818.90	0.01
Hypoplectrus atlahua	DD	Shallow Serranid		0.00					
Hypoplectrus castroaguirrei	EN	Shallow Serranid		0.00					
Hypoplectrus floridae	LC	Shallow Serranid		0.00					
Hypoplectrus maculiferus	DD	Shallow Serranid		0.00					
Hypoplectrus randallorum	LC	Shallow Serranid		0.00					
Pseudogramma gregoryi	LC	Shallow Serranid		0.00					
Rypticus carpenteri	LC	Shallow Serranid		0.00					
		Shallow Serranid	**34640.31**		**26319.00**		**21812112.96**	**23993.32**	**0.03**
Paraclinus marmoratus	LC	Small Demersal Fish	0.00	0.00	36.00		0.63	0.00	0.00
Antennarius pauciradiatus	LC	Small Demersal Fish	0.00	0.00	6.00		1.26	0.00	0.00
Emblemaria atlantica	LC	Small Demersal Fish	0.00	0.00	6.00		1.26	0.00	0.00
Parablennius marmoreus	LC	Small Demersal Fish	0.00	0.00	2571.00		1.26	0.00	0.00
Hypsoblennius ionthas	LC	Small Demersal Fish	0.00	0.00	57.00		1.89	0.00	0.00
Gnatholepis thompsoni	LC	Small Demersal Fish	0.00	0.00	2560.00		1.89	0.00	0.00
Gobiomorus dormitor	LC	Small Demersal Fish	0.00	0.00	7.00		2.52	0.00	0.00
Gobiosoma longipala	LC	Small Demersal Fish	0.00	0.00	17.00		2.52	0.00	0.00
Lopholatilus chamaeleonticeps	EN	Small Demersal Fish	0.00	0.00	18.00		2.52	0.00	0.00
Emblemaria pandionis	LC	Small Demersal Fish	0.00	0.00	53.00		2.52	0.00	0.00
Hypleurochilus bermudensis	LC	Small Demersal Fish	0.01	0.00	80.00		3.78	0.00	0.00
Foetorepus goodenbeani	LC	Small Demersal Fish	0.01	0.00			3.78	0.00	0.00
Paraclinus nigripinnis	LC	Small Demersal Fish	0.01	0.00	6.00		4.41	0.00	0.00
Scorpaena dispar	LC	Small Demersal Fish	0.01	0.00	23.00		4.41	0.00	0.00
Scorpaena agassizii	LC	Small Demersal Fish	0.01	0.00	30.00		5.04	0.01	0.00
Hypsoblennius hentz	LC	Small Demersal Fish	0.01	0.00	36.00		5.04	0.01	0.00
Cantherhines pullus	LC	Small Demersal Fish	0.01	0.00	217.00		8.19	0.01	0.00
Microgobius thalassinus	LC	Small Demersal Fish	0.01	0.00	272.00		8.19	0.01	0.00
Pontinus longispinis	LC	Small Demersal Fish	0.02	0.00	54.00		10.70	0.01	0.00
Gobioides broussonnetii	LC	Small Demersal Fish	0.02	0.00	19.00		11.33	0.01	0.00
Parahollardia lineata	LC	Small Demersal Fish	0.02	0.00	30.00		11.33	0.01	0.00

Stenotomus caprinus	LC	Small Demersal Fish	0.02	0.00	117.00		11.96	0.01	0.00
Scorpaena calcarata	LC	Small Demersal Fish	0.02	0.00	71.00		12.59	0.01	0.00
Lobotes surinamensis	LC	Small Demersal Fish	0.02	0.00	66.00		13.22	0.01	0.00
Bollmannia boqueronensis	LC	Small Demersal Fish	0.02	0.00	60.00		15.11	0.02	0.00
Gobiosoma robustum	LC	Small Demersal Fish	0.03	0.00	3049.00		15.74	0.02	0.00
Synodus synodus	LC	Small Demersal Fish	0.04	0.00	14.00		24.56	0.03	0.00
Neomerinthe hemingwayi	LC	Small Demersal Fish	0.04	0.00	44.00		25.19	0.03	0.00
Lonchopisthus micrognathus	LC	Small Demersal Fish	0.04	0.00	15.00		26.45	0.03	0.00
Pagrus pagrus	LC	Small Demersal Fish	0.04	0.00	21.00		27.08	0.03	0.00
Gunterichthys longipenis	LC	Small Demersal Fish	0.05	0.00	15.00		28.34	0.03	0.00
Chasmodes saburrae	LC	Small Demersal Fish	0.05	0.00	55.00		28.34	0.03	0.00
Stephanolepis hispidus	LC	Small Demersal Fish	0.05	0.00	233.00		28.34	0.03	0.00
Opistognathus robinsi	LC	Small Demersal Fish	0.05	0.00	6.00		30.22	0.03	0.00
Antennarius multiocellatus	LC	Small Demersal Fish	0.05	0.00	11.00		30.85	0.03	0.00
Coryphopterus punctipectophorus	LC	Small Demersal Fish	0.06	0.00	10.00		35.26	0.04	0.00
Gobiesox strumosus	LC	Small Demersal Fish	0.06	0.00	176.00		35.89	0.04	0.00
Histrio histrio	LC	Small Demersal Fish	0.08	0.00	281.00		47.86	0.05	0.00
Emblemaria piratula	LC	Small Demersal Fish	0.08	0.00	18.00		48.48	0.05	0.00
Gobionellus oceanicus	LC	Small Demersal Fish	0.09	0.00	136.00		54.78	0.06	0.00
Caulolatilus microps	DD	Small Demersal Fish	0.09	0.00	10.00		56.67	0.06	0.00
Evermannichthys spongicola	LC	Small Demersal Fish	0.14	0.00	12.00		85.64	0.09	0.00
Parasudis truculenta	LC	Small Demersal Fish	0.14	0.00	28.00		85.64	0.09	0.00
Trachinocephalus myops	LC	Small Demersal Fish	0.14	0.00	34.00		85.64	0.09	0.00
Chaenopsis ocellata	LC	Small Demersal Fish	0.20	0.00	5.00		124.05	0.14	0.00
Gobiosoma bosc	LC	Small Demersal Fish	0.20	0.00	842.00		125.31	0.14	0.00
Pontinus rathbuni	LC	Small Demersal Fish	0.21	0.00	19.00		134.12	0.15	0.00
Opistognathus aurifrons	LC	Small Demersal Fish	0.22	0.00	8038.00		138.53	0.15	0.00
Scorpaena grandicornis	LC	Small Demersal Fish	0.41	0.00	5.00		256.28	0.28	0.00
Microgobius gulosus	LC	Small Demersal Fish	0.41	0.00	1590.00		256.91	0.28	0.00
Cantherhines macrocerus	LC	Small Demersal Fish	0.44	0.00	72.00		273.91	0.30	0.00
Foetorepus agassizii	LC	Small Demersal Fish	0.46	0.00	66.00		292.17	0.32	0.00
Microgobius microlepis	LC	Small Demersal Fish	0.49	0.00	381.00		306.65	0.34	0.00
Diplogrammus pauciradiatus	LC	Small Demersal Fish	0.59	0.00	1147.00		371.51	0.41	0.00
Saurida normani	LC	Small Demersal Fish	0.62	0.00	31.00		388.51	0.43	0.00
Dormitator maculatus	LC	Small Demersal Fish	1.05	0.00	30.00		661.79	0.73	0.00
Monacanthus tuckeri	LC	Small Demersal Fish	1.07	0.00	440.00		671.86	0.74	0.00

Opistognathus lonchurus	LC	Small Demersal Fish	1.66	0.00	14.00		1042.11	1.15	0.00
Bellator brachychir	LC	Small Demersal Fish	2.06	0.00	7.00		1298.39	1.43	0.00
Prionotus alatus	LC	Small Demersal Fish	3.09	0.00	22.00		1947.58	2.14	0.00
Synodus poeyi	LC	Small Demersal Fish	7.05	0.01	38.00		4437.94	4.88	0.00
Antennarius striatus	LC	Small Demersal Fish	7.71	0.01	10.00		4855.42	5.34	0.00
Caulolatilus chrysops	LC	Small Demersal Fish	8.03	0.01	7.00		5058.17	5.56	0.00
Bellator egretta	LC	Small Demersal Fish	8.24	0.01	7.00		5187.26	5.71	0.00
Antigonia capros	LC	Small Demersal Fish	8.63	0.01	20.00		5432.83	5.98	0.00
Scorpaena plumieri	LC	Small Demersal Fish	10.04	0.01	123.00		6320.04	6.95	0.00
Prionotus paralatus	LC	Small Demersal Fish	12.52	0.01	54.00		7884.15	8.67	0.00
Scorpaena inermis	LC	Small Demersal Fish	16.62	0.01	5.00		10463.30	11.51	0.00
Peristedion gracile	LC	Small Demersal Fish	16.91	0.01	32.00		10644.64	11.71	0.00
Risor ruber	LC	Small Demersal Fish	23.08	0.02	10.00		14530.36	15.98	0.00
Antigonia combatia	LC	Small Demersal Fish	27.99	0.02	10.00		17624.58	19.39	0.00
Saurida brasiliensis	LC	Small Demersal Fish	30.29	0.02	161.00		19070.31	20.98	0.00
Caulolatilus intermedius	LC	Small Demersal Fish	34.63	0.03	25.00		21806.88	23.99	0.00
Prionotus tribulus	LC	Small Demersal Fish	42.02	0.03	4169.00		26455.76	29.10	0.00
Aluterus scriptus	LC	Small Demersal Fish	44.01	0.03	631.00		27713.85	30.49	0.00
Malacanthus plumieri	LC	Small Demersal Fish	57.29	0.05	496.00		36072.78	39.68	0.00
Aluterus monoceros	LC	Small Demersal Fish	58.87	0.05	17.00		37066.40	40.77	0.00
Peristedion miniatum	LC	Small Demersal Fish	83.63	0.07	33.00		52661.55	57.93	0.00
Bembrops gobioides	LC	Small Demersal Fish	90.36	0.07	56.00		56897.99	62.59	0.00
Aluterus heudelotii	LC	Small Demersal Fish	128.56	0.10	10.00		80947.77	89.04	0.00
Prionotus longispinosus	LC	Small Demersal Fish	175.93	0.14	419.00		110780.48	121.86	0.00
Bembrops anatirostris	LC	Small Demersal Fish	197.76	0.16	61.00		124525.64	136.98	0.00
Prionotus martis	LC	Small Demersal Fish	202.10	0.16	32.00		127258.42	139.98	0.00
Calamus leucosteus	LC	Small Demersal Fish	285.27	0.23	9.00		179629.06	197.59	0.00
Monacanthus ciliatus	LC	Small Demersal Fish	335.64	0.27	74.00		211341.34	232.48	0.00
Calamus campechanus	DD	Small Demersal Fish	365.86	0.29	2.00		230373.88	253.41	0.00
Labrisomus nuchipinnis	LC	Small Demersal Fish	369.73	0.29	33.00		232810.09	256.09	0.00
Prionotus rubio	LC	Small Demersal Fish	384.12	0.30	370.00		241871.10	266.06	0.00
Synodus macrostigmus	LC	Small Demersal Fish	400.35	0.32			252087.57	277.30	0.00
Bellator militaris	LC	Small Demersal Fish	500.80	0.40	39.00		315338.97	346.87	0.00
Synodus intermedius	LC	Small Demersal Fish	509.74	0.40	390.00		320967.63	353.06	0.00
Pontinus castor	LC	Small Demersal Fish	528.89	0.42	3.00		333026.52	366.33	0.00
Saurida caribbaea	LC	Small Demersal Fish	665.01	0.53	16.00		418737.78	460.61	0.00

Caulolatilus cyanops	LC	Small Demersal Fish	720.30	0.57	25.00		453554.36	498.91	0.00
Bollmannia communis	LC	Small Demersal Fish	806.38	0.64	65.00		507757.98	558.53	0.00
Synodus foetens	LC	Small Demersal Fish	826.79	0.65	4184.00		520609.63	572.67	0.00
Neomerinthe beanorum	LC	Small Demersal Fish	880.59	0.70	0.00		554484.21	609.93	0.00
Prionotus stearnsi	LC	Small Demersal Fish	924.47	0.73	58.00		582114.32	640.33	0.00
Archosargus probatocephalus	LC	Small Demersal Fish	1023.33	0.81	4542.00		644365.17	708.80	0.00
Scorpaena brasiliensis	LC	Small Demersal Fish	1028.75	0.81	24.00		647774.86	712.55	0.00
Prionotus punctatus	LC	Small Demersal Fish	1311.75	1.04	2.00		825974.56	908.57	0.00
Prionotus scitulus	LC	Small Demersal Fish	1625.48	1.28	310.00		1023524.15	1125.88	0.00
Aluterus schoepfii	LC	Small Demersal Fish	1959.44	1.55	105.00		1233811.42	1357.19	0.00
Prionotus roseus	LC	Small Demersal Fish	2514.64	1.99	35.00		1583406.56	1741.75	0.00
Starksia ocellata	LC	Small Demersal Fish	2686.72	2.12	15.00		1691755.24	1860.93	0.00
Prionotus ophryas	LC	Small Demersal Fish	3269.19	2.58	20.00		2058526.63	2264.38	0.00
Prionotus carolinus	LC	Small Demersal Fish	12631.20	9.98	2.00		7953543.21	8748.90	0.01
Chriolepis benthonis	DD	Small Demersal Fish	0.00	0.00	0.00		0.00	0.00	0.00
Guavina guavina	LC	Small Demersal Fish	0.00	0.00	0.00		0.00	0.00	0.00
Microgobius signatus	LC	Small Demersal Fish	0.00	0.00	0.00		0.00	0.00	0.00
Pontinus nematophthalmus	LC	Small Demersal Fish	0.00	0.00	0.00		0.00	0.00	0.00
Tigrigobius macrodon	LC	Small Demersal Fish	0.00	0.00	0.00		0.00	0.00	0.00
Acyrtops beryllinus	LC	Small Demersal Fish	0.95	0.00	1.00		595.44	0.65	0.00
Coryphopterus hyalinus	VU	Small Demersal Fish	0.95	0.00	1.00		595.44	0.65	0.00
Gobioclinus guppyi	LC	Small Demersal Fish	0.95	0.00	1.00		595.44	0.65	0.00
Hypleurochilus springeri	LC	Small Demersal Fish	0.95	0.00	1.00		595.44	0.65	0.00
Lupinoblennius nicholsi	LC	Small Demersal Fish	0.95	0.00	1.00		595.44	0.65	0.00
Starksia lepicoelia	LC	Small Demersal Fish	0.95	0.00	1.00		595.44	0.65	0.00
Starksia starcki	LC	Small Demersal Fish	0.95	0.00	1.00		595.44	0.65	0.00
Stathmonotus hemphillii	LC	Small Demersal Fish	0.95	0.00	1.00		595.44	0.65	0.00
Bathygobius mystacium	LC	Small Demersal Fish	1.89	0.00	2.00		1190.88	1.31	0.00
Emmelichthys ruber	LC	Small Demersal Fish	1.89	0.00	2.00		1190.88	1.31	0.00
Gobioclinus gobio	LC	Small Demersal Fish	1.89	0.00	2.00		1190.88	1.31	0.00
Opistognathus maxillosus	LC	Small Demersal Fish	1.89	0.00	2.00		1190.88	1.31	0.00
Opistognathus nothus	LC	Small Demersal Fish	1.89	0.00	2.00		1190.88	1.31	0.00
Scorpaena albifimbria	LC	Small Demersal Fish	1.89	0.00	2.00		1190.88	1.31	0.00
Varicus marilynae	DD	Small Demersal Fish	1.89	0.00	2.00		1190.88	1.31	0.00
Acanthemblemaria spinosa	LC	Small Demersal Fish	2.84	0.00	3.00		1786.33	1.96	0.00
Coryphopterus thrix	VU	Small Demersal Fish	2.84	0.00	3.00		1786.33	1.96	0.00

Ctenogobius claytonii	VU	Small Demersal Fish	2.84	0.00	3.00		1786.33	1.96	0.00
Emblemariopsis diaphana	LC	Small Demersal Fish	2.84	0.00	3.00		1786.33	1.96	0.00
Gobioclinus bucciferus	LC	Small Demersal Fish	2.84	0.00	3.00		1786.33	1.96	0.00
Gobiosoma grosvenori	LC	Small Demersal Fish	2.84	0.00	3.00		1786.33	1.96	0.00
Lythrypnus elasson	LC	Small Demersal Fish	2.84	0.00	3.00		1786.33	1.96	0.00
Oxyurichthys stigmalophius	LC	Small Demersal Fish	2.84	0.00	3.00		1786.33	1.96	0.00
Bathygobius curacao	LC	Small Demersal Fish	3.78	0.00	4.00		2381.77	2.62	0.00
Gobulus myersi	LC	Small Demersal Fish	3.78	0.00	4.00		2381.77	2.62	0.00
Hypleurochilus caudovittatus	LC	Small Demersal Fish	3.78	0.00	4.00		2381.77	2.62	0.00
Lythrypnus phorellus	LC	Small Demersal Fish	3.78	0.00	4.00		2381.77	2.62	0.00
Lythrypnus spilus	LC	Small Demersal Fish	3.78	0.00	4.00		2381.77	2.62	0.00
Brockius nigricinctus	LC	Small Demersal Fish	4.73	0.00	5.00		2977.21	3.27	0.00
Ctenogobius smaragdus	LC	Small Demersal Fish	4.73	0.00	5.00		2977.21	3.27	0.00
Palatogobius paradoxus	LC	Small Demersal Fish	4.73	0.00	5.00		2977.21	3.27	0.00
Scorpaenodes tredecimspinosus	LC	Small Demersal Fish	4.73	0.00	5.00		2977.21	3.27	0.00
Acanthemblemaria maria	LC	Small Demersal Fish	5.67	0.00	6.00		3572.65	3.93	0.00
Bollmannia eigenmanni	LC	Small Demersal Fish	5.67	0.00	6.00		3572.65	3.93	0.00
Elacatinus prochilos	VU	Small Demersal Fish	5.67	0.00	6.00		3572.65	3.93	0.00
Hypleurochilus multifilis	LC	Small Demersal Fish	5.67	0.00	6.00		3572.65	3.93	0.00
Lythrypnus nesiotes	LC	Small Demersal Fish	5.67	0.00	6.00		3572.65	3.93	0.00
Scorpaena elachys	LC	Small Demersal Fish	5.67	0.00	6.00		3572.65	3.93	0.00
Coryphopterus lipernes	VU	Small Demersal Fish	6.62	0.01	7.00		4168.10	4.58	0.00
Ctenogobius stigmaticus	LC	Small Demersal Fish	6.62	0.01	7.00		4168.10	4.58	0.00
Ctenogobius stigmaturus	LC	Small Demersal Fish	6.62	0.01	7.00		4168.10	4.58	0.00
Eleotris amblyopsis	LC	Small Demersal Fish	6.62	0.01	7.00		4168.10	4.58	0.00
Emblemariopsis bahamensis	LC	Small Demersal Fish	6.62	0.01	7.00		4168.10	4.58	0.00
Scorpaena bergii	LC	Small Demersal Fish	6.62	0.01	7.00		4168.10	4.58	0.00
Barbulifer ceuthoecus	LC	Small Demersal Fish	7.57	0.01	8.00		4763.54	5.24	0.00
Calamopteryx robinsorum	LC	Small Demersal Fish	7.57	0.01	8.00		4763.54	5.24	0.00
Chriolepis vespa	LC	Small Demersal Fish	7.57	0.01	8.00		4763.54	5.24	0.00
Entomacrodus nigricans	LC	Small Demersal Fish	7.57	0.01	8.00		4763.54	5.24	0.00
Lophogobius cyprinoides	LC	Small Demersal Fish	7.57	0.01	8.00		4763.54	5.24	0.00
Malacoctenus versicolor	LC	Small Demersal Fish	7.57	0.01	8.00		4763.54	5.24	0.00
Chaenopsis roseola	LC	Small Demersal Fish	8.51	0.01	9.00		5358.98	5.89	0.00
Erythrocles monodi	LC	Small Demersal Fish	8.51	0.01	9.00		5358.98	5.89	0.00
Nemaclinus atelestos	LC	Small Demersal Fish	8.51	0.01	9.00		5358.98	5.89	0.00

Chasmodes longimaxilla	LC	Small Demersal Fish	9.46	0.01	10.00		5954.42	6.55	0.00
Malacoctenus gilli	LC	Small Demersal Fish	9.46	0.01	10.00		5954.42	6.55	0.00
Ogilbia cayorum	LC	Small Demersal Fish	9.46	0.01	10.00		5954.42	6.55	0.00
Priolepis hipoliti	LC	Small Demersal Fish	11.35	0.01	12.00		7145.31	7.86	0.00
Stephanolepis setifer	LC	Small Demersal Fish	13.24	0.01	14.00		8336.19	9.17	0.00
Scorpaenodes caribbaeus	LC	Small Demersal Fish	14.18	0.01	15.00		8931.64	9.82	0.00
Acanthemblemaria chaplini	LC	Small Demersal Fish	17.02	0.01	18.00		10717.96	11.79	0.00
Nes longus	LC	Small Demersal Fish	17.97	0.01	19.00		11313.40	12.44	0.00
Malacoctenus aurolineatus	LC	Small Demersal Fish	18.91	0.01	20.00		11908.85	13.10	0.00
Fowlerichthys ocellatus	LC	Small Demersal Fish	20.80	0.02	22.00		13099.73	14.41	0.00
Erotelis smaragdus	LC	Small Demersal Fish	22.70	0.02	24.00		14290.62	15.72	0.00
Bathygobius soporator	LC	Small Demersal Fish	28.37	0.02	30.00		17863.27	19.65	0.00
Evorthodus lyricus	LC	Small Demersal Fish	36.88	0.03	39.00		23222.25	25.54	0.00
Callionymus bairdi	LC	Small Demersal Fish	37.83	0.03	40.00		23817.69	26.20	0.00
Opistognathus macrognathus	LC	Small Demersal Fish	40.66	0.03	43.00		25604.02	28.16	0.00
Hypsoblennius invemar	LC	Small Demersal Fish	52.01	0.04	55.00		32749.33	36.02	0.00
Elacatinus evelynae	LC	Small Demersal Fish	52.96	0.04	56.00		33344.77	36.68	0.00
Paraclinus fasciatus	LC	Small Demersal Fish	65.25	0.05	69.00		41085.52	45.19	0.00
Opistognathus whitehursti	LC	Small Demersal Fish	66.19	0.05	70.00		41680.96	45.85	0.00
Scartella cristata	LC	Small Demersal Fish	85.11	0.07	90.00		53589.81	58.95	0.00
Microgobius carri	LC	Small Demersal Fish	103.07	0.08	109.00		64903.22	71.39	0.00
Acanthemblemaria aspera	LC	Small Demersal Fish	124.82	0.10	132.00		78598.39	86.46	0.00
Hemiemblemaria simulus	LC	Small Demersal Fish	161.70	0.13	171.00		101820.64	112.00	0.00
Fowlerichthys radiosus	LC	Small Demersal Fish	196.69	0.16	208.00		123852.01	136.24	0.00
Ctenogobius saepepallens	LC	Small Demersal Fish	243.03	0.19	257.00		153028.68	168.33	0.00
Coryphopterus eidolon	VU	Small Demersal Fish	243.97	0.19	258.00		153624.13	168.99	0.00
Elacatinus xanthiprora	LC	Small Demersal Fish	256.27	0.20	271.00		161364.88	177.50	0.00
Ophioblennius macclurei	LC	Small Demersal Fish	287.47	0.23	304.00		181014.47	199.12	0.00
Ctenogobius shufeldti	LC	Small Demersal Fish	346.10	0.27	366.00		217931.90	239.73	0.00
Malacoctenus macropus	LC	Small Demersal Fish	1026.01	0.81	1085.00		646054.95	710.66	0.00
Coryphopterus dicrus	LC	Small Demersal Fish	1110.18	0.88	1174.00		699049.32	768.95	0.00
Ctenogobius boleosoma	LC	Small Demersal Fish	3117.76	2.46	3297.00		1963173.42	2159.49	0.00
Malacoctenus triangulatus	LC	Small Demersal Fish	5735.28	4.53	6065.00		3611357.84	3972.49	0.00
Elacatinus oceanops	LC	Small Demersal Fish	8081.40	6.38	8546.00		5088650.31	5597.52	0.01
Coryphopterus glaucofraenum	LC	Small Demersal Fish	18931.62	14.96	20020.00		11920755.81	13112.83	0.02
Coryphopterus personatus	VU	Small Demersal Fish	19070.63	15.07	20167.00		12008285.83	13209.11	0.02

Bathygobius antilliensis	LC	Small Demersal Fish		0.00					
Bathygobius lacertus	LC	Small Demersal Fish		0.00					
Bembrops macromma	LC	Small Demersal Fish		0.00					
Chriolepis bilix	LC	Small Demersal Fish		0.00					
Coryphopterus tortugae	VU	Small Demersal Fish		0.00					
Elacatinus jarocho	EN	Small Demersal Fish		0.00					
Eleotris perniger	LC	Small Demersal Fish		0.00					
Gobioclinus filamentosus	LC	Small Demersal Fish		0.00					
Gobioclinus haitiensis	LC	Small Demersal Fish		0.00					
Gobioclinus kalisherae	LC	Small Demersal Fish		0.00					
Grammonus claudei	LC	Small Demersal Fish		0.00					
Lonchopisthus lemur	LC	Small Demersal Fish		0.00					
Malacoctenus erdmani	LC	Small Demersal Fish		0.00					
Ogilbia sabaji	LC	Small Demersal Fish		0.00					
Ogilbia suarezae	LC	Small Demersal Fish		0.00					
Paraclinus grandicomis	LC	Small Demersal Fish		0.00					
Paraclinus infrons	LC	Small Demersal Fish		0.00					
Parrella macropteryx	LC	Small Demersal Fish		0.00					
Psilotris alepis	LC	Small Demersal Fish		0.00					
Starksia fasciata	LC	Small Demersal Fish		0.00					
Starksia nanodes	LC	Small Demersal Fish		0.00					
Starksia weigti	LC	Small Demersal Fish		0.00					
Stathmonotus tekla	LC	Small Demersal Fish		0.00					
Stygnobrotula latebricola	LC	Small Demersal Fish		0.00					
Synodus saurus	LC	Small Demersal Fish		0.00					
Tigrigobius dilepis	LC	Small Demersal Fish		0.00					
Tigrigobius multifasciatus	LC	Small Demersal Fish		0.00					
Tigrigobius redimiculus	VU	Small Demersal Fish		0.00					
Tigrigobius saucrus	LC	Small Demersal Fish		0.00					
Tomicodon reitzae	LC	Small Demersal Fish		0.00					
Tomicodon rupestris	LC	Small Demersal Fish		0.00					
		Small Demersal Fish	**97753.18**		**103373.00**		**61552661.85**	**67707.93**	**0.08**
Hemiramphus brasiliensis	LC	Small Pelagic Fish	0.00	0.00	126.00		1.26	0.00	0.00
Phtheirichthys lineatus	LC	Small Pelagic Fish	0.00	0.00	12.00		1.89	0.00	0.00
Pterycombus brama	LC	Small Pelagic Fish	0.01	0.00	13.00		3.15	0.00	0.00
Engraulis eurystole	LC	Small Pelagic Fish	0.01	0.00	46.00		3.15	0.00	0.00

Pomatomus saltatrix	VU	Small Pelagic Fish	0.01	0.00	39.00		5.04	0.01	0.00
Peprilus paru	LC	Small Pelagic Fish	0.01	0.00	577.00		5.04	0.01	0.00
Echeneis neucratoides	DD	Small Pelagic Fish	0.01	0.00	23.00		6.30	0.01	0.00
Platybelone argalus	LC	Small Pelagic Fish	0.01	0.00			6.30	0.01	0.00
Cheilopogon melanurus	LC	Small Pelagic Fish	0.01	0.00	28.00		8.82	0.01	0.00
Syngnathus pelagicus	LC	Small Pelagic Fish	0.03	0.00	89.00		18.26	0.02	0.00
Bregmaceros cantori	LC	Small Pelagic Fish	0.03	0.00	7.00		18.89	0.02	0.00
Remora remora	LC	Small Pelagic Fish	0.03	0.00	89.00		19.52	0.02	0.00
Exocoetus obtusirostris	LC	Small Pelagic Fish	0.04	0.00	29.00		25.19	0.03	0.00
Nomeus gronovii	LC	Small Pelagic Fish	0.05	0.00	5.00		28.34	0.03	0.00
Hemiramphus balao	LC	Small Pelagic Fish	0.07	0.00	9.00		42.94	0.05	0.00
Strongylura marina	LC	Small Pelagic Fish	0.08	0.00	213.00		51.63	0.06	0.00
Synagrops bellus	LC	Small Pelagic Fish	0.10	0.00	39.00		62.97	0.07	0.00
Membras martinica	LC	Small Pelagic Fish	0.10	0.00	383.00		62.97	0.07	0.00
Menidia beryllina	LC	Small Pelagic Fish	0.12	0.00	3512.00		78.08	0.09	0.00
Polydactylus octonemus	LC	Small Pelagic Fish	0.25	0.00	2561.00		159.94	0.18	0.00
Dactylopterus volitans	LC	Small Pelagic Fish	0.35	0.00	12.00		221.02	0.24	0.00
Anchoa lamprotaenia	LC	Small Pelagic Fish	0.46	0.00	285.00		291.54	0.32	0.00
Cheilopogon furcatus	LC	Small Pelagic Fish	0.62	0.00	51.00		392.29	0.43	0.00
Synagrops spinosus	LC	Small Pelagic Fish	1.27	0.00	21.00		797.80	0.88	0.00
Rachycentron canadum	LC	Small Pelagic Fish	1.32	0.00	82.00		832.43	0.92	0.00
Ablennes hians	LC	Small Pelagic Fish	1.70	0.00	18.00		1070.45	1.18	0.00
Hirundichthys affinis	LC	Small Pelagic Fish	3.61	0.00	20.00		2275.64	2.50	0.00
Zenopsis conchifer	LC	Small Pelagic Fish	4.75	0.00	11.00		2993.47	3.29	0.00
Opisthonema oglinum	LC	Small Pelagic Fish	4.80	0.00	634.00		3020.55	3.32	0.00
Alosa chrysochloris	LC	Small Pelagic Fish	9.39	0.01	37.00		5909.49	6.50	0.00
Polydactylus virginicus	LC	Small Pelagic Fish	9.91	0.01	1.00		6240.07	6.86	0.00
Bregmaceros atlanticus	LC	Small Pelagic Fish	10.40	0.01	339.00		6549.87	7.20	0.00
Hyporhamphus unifasciatus	LC	Small Pelagic Fish	15.17	0.01	26.00		9552.16	10.51	0.00
Remora australis	LC	Small Pelagic Fish	52.52	0.04	11.00		33069.86	36.38	0.00
Anchoviella perfasciata	LC	Small Pelagic Fish	59.36	0.05	4.00		37375.57	41.11	0.00
Anchoa lyolepis	LC	Small Pelagic Fish	81.37	0.06	4860.00		51235.33	56.36	0.00
Peprilus burti	LC	Small Pelagic Fish	153.01	0.12	6948.00		96347.72	105.98	0.00
Echeneis naucrates	LC	Small Pelagic Fish	156.36	0.12	294.00		98457.12	108.30	0.00
Jenkinsia lamprotaenia	LC	Small Pelagic Fish	297.50	0.24	14.00		187325.57	206.06	0.00
Anchoa hepsetus	LC	Small Pelagic Fish	4544.79	3.59	7982.00		2861737.84	3147.91	0.00

Anchoa parva	LC	Small Pelagic Fish	0.00	0.00	0.00		0.00	0.00	0.00
Cetengraulis edentulus	LC	Small Pelagic Fish	0.00	0.00	0.00		0.00	0.00	0.00
Polydactylus oligodon	LC	Small Pelagic Fish	0.00	0.00	0.00		0.00	0.00	0.00
Chirocentrodon bleekerianus	LC	Small Pelagic Fish	0.18	0.00	1.00		115.66	0.13	0.00
Cypselurus comatus	LC	Small Pelagic Fish	0.18	0.00	1.00		115.66	0.13	0.00
Etrumeus sadina	LC	Small Pelagic Fish	0.18	0.00	1.00		115.66	0.13	0.00
Melanorhinus microps	LC	Small Pelagic Fish	0.18	0.00	1.00		115.66	0.13	0.00
Menidia conchorum	EN	Small Pelagic Fish	0.18	0.00	1.00		115.66	0.13	0.00
Jenkinsia majua	LC	Small Pelagic Fish	0.37	0.00	2.00		231.33	0.25	0.00
Psenes pellucidus	LC	Small Pelagic Fish	0.37	0.00	2.00		231.33	0.25	0.00
Hyporhamphus meeki	LC	Small Pelagic Fish	0.73	0.00	4.00		462.66	0.51	0.00
Synagrops trispinosus	LC	Small Pelagic Fish	0.73	0.00	4.00		462.66	0.51	0.00
Hirundichthys speculiger	LC	Small Pelagic Fish	0.92	0.00	5.00		578.32	0.64	0.00
Jenkinsia stolifera	LC	Small Pelagic Fish	0.92	0.00	5.00		578.32	0.64	0.00
Exocoetus volitans	LC	Small Pelagic Fish	1.10	0.00	6.00		693.98	0.76	0.00
Cubiceps gracilis	LC	Small Pelagic Fish	1.47	0.00	8.00		925.31	1.02	0.00
Alosa alabamae	DD	Small Pelagic Fish	1.65	0.00	9.00		1040.98	1.15	0.00
Euleptorhamphus velox	LC	Small Pelagic Fish	1.65	0.00	9.00		1040.98	1.15	0.00
Harengula clupeola	LC	Small Pelagic Fish	1.65	0.00	9.00		1040.98	1.15	0.00
Anchoa cubana	LC	Small Pelagic Fish	1.84	0.00	10.00		1156.64	1.27	0.00
Brama dussumieri	LC	Small Pelagic Fish	2.02	0.00	11.00		1272.30	1.40	0.00
Bregmaceros houdei	LC	Small Pelagic Fish	2.02	0.00	11.00		1272.30	1.40	0.00
Prognichthys occidentalis	LC	Small Pelagic Fish	2.02	0.00	11.00		1272.30	1.40	0.00
Remora albescens	LC	Small Pelagic Fish	2.02	0.00	11.00		1272.30	1.40	0.00
Psenes cyanophrys	LC	Small Pelagic Fish	2.20	0.00	12.00		1387.97	1.53	0.00
Gempylus serpens	LC	Small Pelagic Fish	2.57	0.00	14.00		1619.30	1.78	0.00
Parexocoetus hillianus	LC	Small Pelagic Fish	2.76	0.00	15.00		1734.96	1.91	0.00
Taractichthys longipinnis	LC	Small Pelagic Fish	2.76	0.00	15.00		1734.96	1.91	0.00
Cheilopogon exsiliens	LC	Small Pelagic Fish	3.12	0.00	17.00		1966.29	2.16	0.00
Hyperoglyphe bythites	LC	Small Pelagic Fish	3.12	0.00	17.00		1966.29	2.16	0.00
Strongylura timucu	LC	Small Pelagic Fish	3.12	0.00	17.00		1966.29	2.16	0.00
Chriodorus atherinoides	LC	Small Pelagic Fish	3.49	0.00	19.00		2197.62	2.42	0.00
Fundulus pulvereus	LC	Small Pelagic Fish	3.49	0.00	19.00		2197.62	2.42	0.00
Remora brachyptera	LC	Small Pelagic Fish	3.49	0.00	19.00		2197.62	2.42	0.00
Fundulus jenkinsi	VU	Small Pelagic Fish	3.67	0.00	20.00		2313.28	2.54	0.00
Cheilopogon cyanopterus	LC	Small Pelagic Fish	4.78	0.00	26.00		3007.26	3.31	0.00

Harengula humeralis	LC	Small Pelagic Fish	4.78	0.00	26.00		3007.26	3.31	0.00
Hypoatherina harringtonensis	LC	Small Pelagic Fish	6.80	0.01	37.00		4279.57	4.71	0.00
Remora osteochir	LC	Small Pelagic Fish	6.80	0.01	37.00		4279.57	4.71	0.00
Atherinomorus stipes	LC	Small Pelagic Fish	22.41	0.02	122.00		14111.01	15.52	0.00
Menidia peninsulae	LC	Small Pelagic Fish	433.32	0.34	2359.00		272851.43	300.14	0.00
Fundulus grandis	LC	Small Pelagic Fish	527.37	0.42	2871.00		332071.41	365.28	0.00
Fundulus similis	LC	Small Pelagic Fish	761.94	0.60	4148.00		479774.36	527.75	0.00
Anchoa cayorum	LC	Small Pelagic Fish		0.00					
Anchoa colonensis	LC	Small Pelagic Fish		0.00					
Anchovia clupeoides	LC	Small Pelagic Fish		0.00					
Fundulus grandissimus	VU	Small Pelagic Fish		0.00					
Fundulus persimilis	EN	Small Pelagic Fish		0.00					
Fundulus xenica	LC	Small Pelagic Fish		0.00					
Hirundichthys volador	LC	Small Pelagic Fish		0.00					
Menidia clarkhubbsi	DD	Small Pelagic Fish		0.00					
Menidia colei	EN	Small Pelagic Fish		0.00					
Neoopisthopterus cubanus	VU	Small Pelagic Fish		0.00					
Oxyporhamphus similis	LC	Small Pelagic Fish		0.00					
Strongylura notata	LC	Small Pelagic Fish		0.00					
Tylosurus acus ssp. acus	LC	Small Pelagic Fish		0.00					
Tylosurus crocodilus ssp. crocodilus	LC	Small Pelagic Fish		0.00					
Verilus sordidus	LC	Small Pelagic Fish		0.00					
		Small Pelagic Fish	**7234.03**		**39382.00**		**4555080.50**	**5010.59**	**0.01**
Chaetodon striatus	LC	Small Reef Fish	0.00	0.00	1729.00		0.63	0.00	0.00
Nicholsina usta	LC	Small Reef Fish	0.00	0.00			0.63	0.00	0.00
Decodon puellaris	LC	Small Reef Fish	0.00	0.00	41.00		1.26	0.00	0.00
Kyphosus sectatrix	LC	Small Reef Fish	0.00	0.00	5606.00	5.50	1.26	0.00	0.00
Lachnolaimus maximus	VU	Small Reef Fish	0.01	0.00	13195.00	10.40	3.15	0.00	0.00
Apogon pillionatus	LC	Small Reef Fish	0.01	0.00	1.00		3.78	0.00	0.00
Apogon phenax	LC	Small Reef Fish	0.01	0.00	2.00		3.78	0.00	0.00
Apogon planifrons	LC	Small Reef Fish	0.01	0.00	6.00		3.78	0.00	0.00
Canthidermis sufflamen	LC	Small Reef Fish	0.01	0.00	746.00	6.00	5.04	0.01	0.00
Phaeoptyx conklini	LC	Small Reef Fish	0.01	0.00	11.00		5.67	0.01	0.00
Conodon nobilis	LC	Small Reef Fish	0.01	0.00	9.00	0.55	6.93	0.01	0.00
Pomacanthus paru	LC	Small Reef Fish	0.01	0.00	2928.00		8.19	0.01	0.00
Lagocephalus laevigatus	LC	Small Reef Fish	0.01	0.00	61.00	4.70	8.82	0.01	0.00
Balistes vetula	NT	Small Reef Fish	0.02	0.00	119.00	5.10	10.07	0.01	0.00

Astrapogon stellatus	DD	Small Reef Fish	0.02	0.00	5.00		10.70	0.01	0.00
Cryptotomus roseus	LC	Small Reef Fish	0.02	0.00	2287.00		15.11	0.02	0.00
Astrapogon puncticulatus	LC	Small Reef Fish	0.03	0.00	5.00		15.74	0.02	0.00
Chilomycterus schoepfii	LC	Small Reef Fish	0.04	0.00	1140.00	0.61	22.67	0.02	0.00
Upeneus parvus	LC	Small Reef Fish	0.04	0.00	19.00	0.07	25.82	0.03	0.00
Mulloidichthys martinicus	LC	Small Reef Fish	0.04	0.00	3376.00		27.71	0.03	0.00
Haemulon carbonarium	LC	Small Reef Fish	0.05	0.00	1718.00		28.34	0.03	0.00
Diodon hystrix	LC	Small Reef Fish	0.05	0.00	191.00	2.50	28.97	0.03	0.00
Canthigaster rostrata	LC	Small Reef Fish	0.05	0.00	8165.00		32.74	0.04	0.00
Chromis enchrysura	LC	Small Reef Fish	0.06	0.00	1342.00		40.30	0.04	0.00
Halichoeres caudalis	LC	Small Reef Fish	0.07	0.00	24.00	0.14	44.08	0.05	0.00
Myripristis jacobus	LC	Small Reef Fish	0.08	0.00	157.00		48.48	0.05	0.00
Halichoeres garnoti	LC	Small Reef Fish	0.09	0.00	41163.00		55.41	0.06	0.00
Chromis insolata	LC	Small Reef Fish	0.09	0.00	2013.00		56.67	0.06	0.00
Corniger spinosus	LC	Small Reef Fish	0.10	0.00	14.00		63.60	0.07	0.00
Abudefduf saxatilis	LC	Small Reef Fish	0.11	0.00	9694.00	0.19	68.00	0.07	0.00
Calamus proridens	LC	Small Reef Fish	0.13	0.00	144.00		82.49	0.09	0.00
Anisotremus surinamensis	DD	Small Reef Fish	0.14	0.00	302.00	5.50	86.27	0.09	0.00
Sparisoma atomarium	LC	Small Reef Fish	0.15	0.00	11382.00		92.56	0.10	0.00
Orthopristis chrysoptera	LC	Small Reef Fish	0.25	0.00	5359.00	0.85	154.90	0.17	0.00
Xanthichthys ringens	LC	Small Reef Fish	0.31	0.00	31.00		192.68	0.21	0.00
Phaeoptyx pigmentaria	LC	Small Reef Fish	0.31	0.00	8.00		194.57	0.21	0.00
Ostichthys trachypoma	LC	Small Reef Fish	0.33	0.00	6.00		209.05	0.23	0.00
Chaetodon sedentarius	LC	Small Reef Fish	0.33	0.00	4309.00		210.31	0.23	0.00
Diodon holocanthus	LC	Small Reef Fish	0.35	0.00	164.00		217.24	0.24	0.00
Sphoeroides dorsalis	LC	Small Reef Fish	0.35	0.00	21.00		221.02	0.24	0.00
Chilomycterus antillarum	LC	Small Reef Fish	0.35	0.00	5.00		221.65	0.24	0.00
Syngnathus springeri	LC	Small Reef Fish	0.40	0.00	13.00		250.61	0.28	0.00
Apogon maculatus	LC	Small Reef Fish	0.40	0.00	170.00		253.13	0.28	0.00
Lactophrys trigonus	LC	Small Reef Fish	0.48	0.00	93.00	3.10	300.98	0.33	0.00
Chaetodon capistratus	LC	Small Reef Fish	0.50	0.00	211643.00		314.21	0.35	0.00
Haemulon striatum	LC	Small Reef Fish	0.51	0.00	459.00		320.50	0.35	0.00
Bodianus pulchellus	LC	Small Reef Fish	0.52	0.00	472.00		327.43	0.36	0.00
Chilomycterus antennatus	LC	Small Reef Fish	0.56	0.00	24.00		350.10	0.39	0.00
Calamus penna	LC	Small Reef Fish	0.57	0.00	193.00	0.90	355.77	0.39	0.00
Astrapogon alutus	LC	Small Reef Fish	0.77	0.00	7.00		486.11	0.53	0.00
Chromis scotti	LC	Small Reef Fish	0.84	0.00	19229.00		527.67	0.58	0.00
Haemulon plumierii	LC	Small Reef Fish	0.91	0.00	36875.00	4.10	574.26	0.63	0.00

Holacanthus ciliaris	LC	Small Reef Fish	0.98	0.00	5235.00	1.45	617.08	0.68	0.00
Phaeoptyx xenus	LC	Small Reef Fish	1.04	0.00	20.00		653.60	0.72	0.00
Apogon quadrisquamatus	LC	Small Reef Fish	1.36	0.00	12.00		856.36	0.94	0.00
Microspathodon chrysurus	LC	Small Reef Fish	1.68	0.00	4220.00		1059.74	1.17	0.00
Acanthurus chirurgus	LC	Small Reef Fish	1.73	0.00	13105.00	4.90	1086.82	1.20	0.00
Haemulon melanurum	LC	Small Reef Fish	1.76	0.00	1111.00	0.50	1110.75	1.22	0.00
Halichoeres bivittatus	LC	Small Reef Fish	2.07	0.00	42660.00	0.14	1304.06	1.43	0.00
Canthigaster jamestyleri	LC	Small Reef Fish	2.19	0.00	5.00		1378.99	1.52	0.00
Holacanthus bermudensis	LC	Small Reef Fish	2.64	0.00	9292.00		1664.86	1.83	0.00
Haemulon aurolineatum	LC	Small Reef Fish	3.18	0.00	11426.00	0.85	1999.22	2.20	0.00
Canthidermis maculata	LC	Small Reef Fish	3.25	0.00	9.00		2048.96	2.25	0.00
Fistularia tabacaria	LC	Small Reef Fish	3.30	0.00	28.00	0.27	2079.81	2.29	0.00
Pseudupeneus maculatus	LC	Small Reef Fish	3.66	0.00	9972.00		2306.50	2.54	0.00
Sphoeroides spengleri	LC	Small Reef Fish	4.10	0.00	361.00		2581.03	2.84	0.00
Calamus calamus	LC	Small Reef Fish	4.14	0.00	14861.00	0.65	2606.22	2.87	0.00
Priacanthus arenatus	LC	Small Reef Fish	4.53	0.00	192.00	2.70	2850.54	3.14	0.00
Halichoeres bathyphilus	LC	Small Reef Fish	4.58	0.00	10.00		2880.76	3.17	0.00
Sphoeroides testudineus	LC	Small Reef Fish	4.65	0.00	5.00	0.36	2926.73	3.22	0.00
Apogon aurolineatus	LC	Small Reef Fish	5.03	0.00	42.00		3169.15	3.49	0.00
Pomacanthus arcuatus	LC	Small Reef Fish	5.04	0.00	10282.00	1.50	3172.30	3.49	0.00
Holocentrus adscensionis	LC	Small Reef Fish	5.32	0.00	3035.00		3348.61	3.68	0.00
Epinephelus adscensionis	LC	Small Reef Fish	6.76	0.01	908.00	3.90	4258.49	4.68	0.00
Aulostomus maculatus	LC	Small Reef Fish	6.99	0.01	1235.00		4403.31	4.84	0.00
Sphoeroides nephelus	LC	Small Reef Fish	9.37	0.01	23.00		5901.94	6.49	0.00
Apogon pseudomaculatus	LC	Small Reef Fish	9.93	0.01	237.00		6252.04	6.88	0.00
Anisotremus virginicus	LC	Small Reef Fish	16.37	0.01	11076.00	0.90	10305.25	11.34	0.00
Fistularia petimba	LC	Small Reef Fish	17.34	0.01	11.00	4.50	10919.81	12.01	0.00
Argentina striata	LC	Small Reef Fish	24.74	0.02	76.00		15579.40	17.14	0.00
Mullus auratus	LC	Small Reef Fish	31.37	0.02	26.00		19753.51	21.73	0.00
Chromis cyanea	LC	Small Reef Fish	33.59	0.03	9761.00		21150.13	23.27	0.00
Chaetodon ocellatus	LC	Small Reef Fish	38.14	0.03	9769.00		24012.63	26.41	0.00
Calamus bajonado	LC	Small Reef Fish	39.63	0.03	220.00	10.30	24955.88	27.45	0.00
Lactophrys triqueter	LC	Small Reef Fish	40.42	0.03	693.00		25453.32	28.00	0.00
Calamus nodosus	LC	Small Reef Fish	70.05	0.06	210.00	2.40	44106.79	48.52	0.00
Haemulon sciurus	LC	Small Reef Fish	98.43	0.08	13362.00	0.70	61981.35	68.18	0.00
Holocentrus rufus	LC	Small Reef Fish	189.17	0.15	2109.00		119116.74	131.03	0.00
Sphoeroides parvus	LC	Small Reef Fish	269.52	0.21	7308.00		169709.17	186.68	0.00
Pomadasys crocro	DD	Small Reef Fish	437.79	0.35	4.00	1.60	275666.98	303.23	0.00

Plectrypops retrospinis	LC	Small Reef Fish	782.46	0.62	6.00		492694.91	541.96	0.00
Halichoeres poeyi	LC	Small Reef Fish	918.37	0.73	2293.00		578273.94	636.10	0.00
Sphoeroides pachygaster	LC	Small Reef Fish	1202.16	0.95	9.00		756969.82	832.67	0.00
Acanthostracion quadricornis	LC	Small Reef Fish	1478.00	1.17	453.00		930658.53	1023.72	0.00
Haemulon parra	LC	Small Reef Fish	2323.35	1.84	1512.00		1462950.51	1609.25	0.00
Balistes capriscus	VU	Small Reef Fish	2380.98	1.88	593.00	6.00	1499242.41	1649.17	0.00
Calamus pennatula	LC	Small Reef Fish	3282.87	2.59	1.00		2067138.69	2273.85	0.00
Pristigenys alta	LC	Small Reef Fish	11109.94	8.78	32.00		6995644.33	7695.21	0.01
Sparisoma chrysopterum	LC	Small Reef Fish	11665.99	9.22	5150.00		7345772.18	8080.35	0.01
Lagocephalus lagocephalus	LC	Small Reef Fish	20447.12	16.15	0.00	3.00	12875022.95	14162.53	0.02
Acanthurus tractus	LC	Small Reef Fish	0.00	0.00	0.00		0.00	0.00	0.00
Haemulon boschmae	LC	Small Reef Fish	0.00	0.00	0.00		0.00	0.00	0.00
Prognathodes guyanensis	LC	Small Reef Fish	0.00	0.00	0.00		0.00	0.00	0.00
Apogon lachneri	LC	Small Reef Fish	0.10	0.00	1.00		61.93	0.07	0.00
Diodon eydouxii	LC	Small Reef Fish	0.10	0.00	1.00		61.93	0.07	0.00
Microdesmus carri	LC	Small Reef Fish	0.10	0.00	1.00		61.93	0.07	0.00
Micrognathus crinitus	LC	Small Reef Fish	0.20	0.00	2.00		123.86	0.14	0.00
Cerdale floridana	LC	Small Reef Fish	0.39	0.00	4.00		247.72	0.27	0.00
Enneanectes jordani	LC	Small Reef Fish	0.39	0.00	4.00		247.72	0.27	0.00
Lipogramma anabantoides	LC	Small Reef Fish	0.39	0.00	4.00		247.72	0.27	0.00
Enneanectes altivelis	LC	Small Reef Fish	0.49	0.00	5.00		309.64	0.34	0.00
Enneanectes pectoralis	LC	Small Reef Fish	0.49	0.00	5.00		309.64	0.34	0.00
Lipogramma trilineata	LC	Small Reef Fish	0.49	0.00	5.00		309.64	0.34	0.00
Sargocentron poco	LC	Small Reef Fish	0.49	0.00	5.00		309.64	0.34	0.00
Microdesmus lanceolatus	LC	Small Reef Fish	0.59	0.00	6.00		371.57	0.41	0.00
Haemulon bonariense	LC	Small Reef Fish	0.69	0.00	7.00		433.50	0.48	0.00
Microdesmus longipinnis	LC	Small Reef Fish	0.69	0.00	7.00		433.50	0.48	0.00
Abudefduf taurus	LC	Small Reef Fish	0.79	0.00	8.00		495.43	0.54	0.00
Chilomycterus reticulatus	LC	Small Reef Fish	0.79	0.00	8.00		495.43	0.54	0.00
Doratonotus megalepis	LC	Small Reef Fish	0.79	0.00	8.00	0.01	495.43	0.54	0.00
Sargocentron bullisi	LC	Small Reef Fish	1.08	0.00	11.00		681.22	0.75	0.00
Prognathodes aya	LC	Small Reef Fish	1.48	0.00	15.00		928.93	1.02	0.00
Cosmocampus albirostris	LC	Small Reef Fish	1.87	0.00	19.00		1176.65	1.29	0.00
Enneanectes boehlkei	LC	Small Reef Fish	1.97	0.00	20.00		1238.58	1.36	0.00
Emmelichthyops atlanticus	LC	Small Reef Fish	2.46	0.00	25.00		1548.22	1.70	0.00
Glossanodon pygmaeus	LC	Small Reef Fish	2.46	0.00	25.00		1548.22	1.70	0.00
Prognathodes aculeatus	LC	Small Reef Fish	3.05	0.00	31.00		1919.79	2.11	0.00
Apogon townsendi	LC	Small Reef Fish	3.84	0.00	39.00		2415.22	2.66	0.00

Neoniphon marianus	LC	Small Reef Fish	4.03	0.00	41.00		2539.08	2.79	0.00
Melichthys niger	LC	Small Reef Fish	4.13	0.00	42.00		2601.01	2.86	0.00
Gramma loreto	LC	Small Reef Fish	5.11	0.00	52.00		3220.30	3.54	0.00
Centropyge argi	LC	Small Reef Fish	5.21	0.00	53.00		3282.23	3.61	0.00
Sargocentron coruscum	LC	Small Reef Fish	5.80	0.00	59.00		3653.80	4.02	0.00
Sargocentron vexillarium	LC	Small Reef Fish	8.16	0.01	83.00		5140.09	5.65	0.00
Amblycirrhitus pinos	LC	Small Reef Fish	8.85	0.01	90.00		5573.60	6.13	0.00
Pempheris schomburgkii	LC	Small Reef Fish	9.24	0.01	94.00		5821.31	6.40	0.00
Acanthostracion polygonius	LC	Small Reef Fish	9.44	0.01	96.00	0.15	5945.17	6.54	0.00
Apogon binotatus	LC	Small Reef Fish	12.39	0.01	126.00		7803.03	8.58	0.00
Halichoeres pictus	LC	Small Reef Fish	13.18	0.01	134.00		8298.47	9.13	0.00
Xyrichtys novacula	LC	Small Reef Fish	13.18	0.01	134.00		8298.47	9.13	0.00
Heteropriacanthus cruentatus	LC	Small Reef Fish	16.92	0.01	172.00	2.50	10651.76	11.72	0.00
Lactophrys bicaudalis	LC	Small Reef Fish	18.88	0.01	192.00		11890.34	13.08	0.00
Halichoeres cyanocephalus	LC	Small Reef Fish	25.57	0.02	260.00		16101.50	17.71	0.00
Ptereleotris helenae	LC	Small Reef Fish	28.42	0.02	289.00		17897.44	19.69	0.00
Cephalopholis fulva	LC	Small Reef Fish	34.32	0.03	349.00		21613.17	23.77	0.00
Haemulon vittatum	LC	Small Reef Fish	51.04	0.04	519.00		32141.07	35.36	0.00
Xyrichtys martinicensis	LC	Small Reef Fish	51.54	0.04	524.00		32450.71	35.70	0.00
Haemulon album	DD	Small Reef Fish	65.89	0.05	670.00	6.90	41492.33	45.64	0.00
Haemulon macrostomum	LC	Small Reef Fish	106.02	0.08	1078.00	0.80	66759.29	73.44	0.00
Stegastes diencaeus	LC	Small Reef Fish	107.89	0.09	1097.00		67935.94	74.73	0.00
Haemulon chrysargyreum	LC	Small Reef Fish	134.54	0.11	1368.00		84718.66	93.19	0.00
Sparisoma radians	LC	Small Reef Fish	159.82	0.13	1625.00		100634.37	110.70	0.00
Scarus coelestinus	DD	Small Reef Fish	164.25	0.13	1670.00	6.70	103421.17	113.76	0.00
Scarus vetula	LC	Small Reef Fish	188.44	0.15	1916.00		118655.67	130.52	0.00
Xyrichtys splendens	LC	Small Reef Fish	209.00	0.17	2125.00		131598.80	144.76	0.00
Scarus guacamaia	NT	Small Reef Fish	209.09	0.17	2126.00	19.00	131660.72	144.83	0.00
Scarus coeruleus	LC	Small Reef Fish	225.52	0.18	2293.00		142002.84	156.20	0.00
Chaetodipterus faber	LC	Small Reef Fish	243.32	0.19	2474.00	8.50	153211.96	168.53	0.00
Ptereleotris calliura	LC	Small Reef Fish	294.95	0.23	2999.00		185724.61	204.30	0.00
Sparisoma rubripinne	LC	Small Reef Fish	421.92	0.33	4290.00		265674.74	292.24	0.00
Holacanthus tricolor	LC	Small Reef Fish	425.27	0.34	4324.00		267780.32	294.56	0.00
Stegastes adustus	LC	Small Reef Fish	465.00	0.37	4728.00		292799.58	322.08	0.00
Halichoeres radiatus	LC	Small Reef Fish	467.26	0.37	4751.00		294223.94	323.65	0.00
Scarus taeniopterus	LC	Small Reef Fish	543.68	0.43	5528.00		342342.65	376.58	0.00
Stegastes leucostictus	LC	Small Reef Fish	628.56	0.50	6391.00		395787.25	435.37	0.00
Clepticus parrae	LC	Small Reef Fish	633.38	0.50	6440.00	0.30	398821.76	438.70	0.00

Bodianus rufus	LC	Small Reef Fish	639.67	0.51	6504.00	0.90	402785.21	443.06	0.00
Chromis multilineata	LC	Small Reef Fish	640.95	0.51	6517.00		403590.28	443.95	0.00
Stegastes planifrons	LC	Small Reef Fish	1009.77	0.80	10267.00		635823.45	699.41	0.00
Haemulon flavolineatum	LC	Small Reef Fish	1475.65	1.17	15004.00		929180.39	1022.10	0.00
Sparisoma viride	LC	Small Reef Fish	2071.17	1.64	21059.00	1.40	1304159.54	1434.58	0.00
Halichoeres maculipinna	LC	Small Reef Fish	2120.54	1.68	21561.00		1335247.82	1468.77	0.00
Acanthurus coeruleus	LC	Small Reef Fish	3115.45	2.46	31677.00		1961720.02	2157.89	0.00
Sparisoma aurofrenatum	LC	Small Reef Fish	4346.41	3.43	44193.00		2736821.44	3010.50	0.00
Stegastes partitus	LC	Small Reef Fish	4404.93	3.48	44788.00		2773669.10	3051.04	0.00
Scarus iseri	LC	Small Reef Fish	5715.45	4.52	58113.00		3598870.96	3958.76	0.00
Thalassoma bifasciatum	LC	Small Reef Fish	6427.11	5.08	65349.00		4046988.08	4451.69	0.01
Acentronura dendritica	LC	Small Reef Fish		0.00					
Apogon robinsi	LC	Small Reef Fish		0.00					
Diplodus argenteus ssp. caudimacula	LC	Small Reef Fish		0.00		2.30			
Halichoeres burekae	EN	Small Reef Fish		0.00					
Kyphosus cinerascens	LC	Small Reef Fish		0.00					
Kyphosus vaigiensis	LC	Small Reef Fish		0.00					
Lipogramma regia	LC	Small Reef Fish		0.00					
Paroncheilus affinis	LC	Small Reef Fish		0.00					
Pempheris poeyi	LC	Small Reef Fish		0.00					
Stegastes otophorus	DD	Small Reef Fish		0.00					
Stegastes xanthurus	LC	Small Reef Fish		0.00					
		Small Reef Fish	**95020.06**		**966136.00**	**3.11**	**59831686.36**	**65814.86**	**0.08**
Centropomus poeyi	DD	Snook		0.00	1.00	8.50	8.50	0.01	0.00
Centropomus ensiferus	LC	Snook		0.00	2.00	0.98	1.96	0.00	0.00
Centropomus mexicanus	LC	Snook		0.00	2.00		0.00	0.00	0.00
Centropomus parallelus	LC	Snook		0.00	4.00	4.60	18.40	0.02	0.00
Centropomus pectinatus	LC	Snook		0.00	4.00	1.30	5.20	0.01	0.00
Centropomus undecimalis	LC	Snook		0.00	236.00	23.50	5546.00	6.10	0.00
		Snook	**0.00**	0.00	**249.00**	**7.78**	**5580.06**	**6.14**	**0.00**
Scomberomorus maculatus	LC	Spanish Mackerel	0.11	0.00	245.00	5.60	68.00	0.07	0.00
		Spanish Mackerel	**0.11**		**245.00**	**5.60**	68.00	0.07	0.00
Sardinella aurita	LC	Spanish Sardine	2.15	0.00	52.00	0.20	1353.80	1.49	0.00
		Spanish Sardine	**2.15**		**52.00**	**0.20**	1353.80	1.49	0.00
Xiphias gladius	LC	Swordfish	376.86	0.30	43386.00	620.00	237299.04	261.03	0.00
		Swordfish	**376.86**		**43386.00**	**620.00**	237299.04	261.03	0.00
Rhomboplites aurorubens	VU	Vermilion Snapper	2.90	0.00	46.00	3.00	1826.06	2.01	0.00
		Vermilion	**0.00**		**0.00**	**3.00**	1826.06	2.01	0.00

		Snapper							
Thunnus albacares	NT	Yellowfin Tuna		0.00	63371.00	185.00	11723635.00	12896.00	0.02
		Yellowfin Tuna	**0.00**		**63371.00**	**185.00**	11723635.00	12896.00	0.02

APPENDIX C

CHONDRICHTHYAN SPECIES LIST AND ASSOCIATED DATA

Genus species	Global RL	Functional Group	Northern Estimates (NOAA SEAMAPS [kg])	Weight (kg) / Total Area Trawled (km2)	Northern Estimates (OBIS)	Average Adult Weight (kg)	Northern Biomass (kg)	Northern Biomass Estimate (t)	Northern Estimate t/km^2
Apristurus laurussonii	DD	Benthic Feeding Shark	0.060923	4.81E-05	88		38.36169	0.042198	5.294E-08
Apristurus parvipinnis	DD	Benthic Feeding Shark	0.032538	2.57E-05	47		20.48863	0.022537	2.82748E-08
Apristurus riveri	DD	Benthic Feeding Shark	0.011077	8.75E-06	16		6.974853	0.007672	9.62545E-09
Galeus arae	LC	Benthic Feeding Shark	0.058154	4.59E-05	84		36.61798	0.04028	5.05336E-08
Ginglymostoma cirratum Western Atlantic subpopulation	NT	Benthic Feeding Shark	0.057	4.5E-05		90	35.89143	0.039481	4.9531E-08
Scyliorhinus meadi	DD	Benthic Feeding Shark		0	0		0	0	0
Scyliorhinus retifer	LC	Benthic Feeding Shark	0.002	1.58E-06	155		1.259348	0.001385	1.73793E-09
Squatina dumeril	DD	Benthic Feeding Shark	0.133	0.000105	40	18	83.74667	0.092121	1.15572E-07
Rhinobatos lentiginosus / Pseudobatos lentiginosus	NT	Benthic Feeding Shark	0.735	0.000581			462.8106	0.509092	6.38689E-07
		Benthic Feeding Shark	**1.089692**	**0.000861**	**430**	**54**	**686.1512**	**0.754766**	**9.46904E-07**
Carcharhinus limbatus	NT	Blacktip Shark	25.65	0.020263	65	100	16151.14	17.76626	2.22889E-05
		Blacktip Shark	**25.65**	0.020263	**65**	**100**	**16151.14**	**17.76626**	**2.22889E-05**
Hydrolagus alberti	DD	Deep Water Fish	1.377	0.001088	84		867.0614	0.953768	1.19656E-06
Hydrolagus mirabilis	NT	Deep Water Fish	0.671	0.00053	15		422.5114	0.464763	5.83075E-07
Rhinochimaera atlantica	LC	Deep Water Fish	10.865	0.008583	28		6841.411	7.525552	9.4413E-06
		Deep Water Fish	**64.213**	0.050726	**257**		**8130.984**	**8.944082**	**1.12209E-05**
Manta birostris / Mobula birostris	VU	Filter Feeding Sharks	0.003	2.37E-06		2300	1.889023	0.002078	2.60689E-09
Rhincodon typus	EN	Filter Feeding Sharks		0	99	25000	2475000	2722.5	0.003415554
		Filter Feeding Sharks	**0.003**	2.37E-06	**99**	**13650**	**2475002**	**2722.502**	**0.003415556**
Oxynotus caribbaeus	DD	Large Sharks		0	0		0	0	0
Odontaspis ferox	VU	Large Sharks	0.514179	0.000406	1	210	0.323766	0.000356	4.46803E-10
Hexanchus nakamurai	DD	Large Sharks	1.542538	0.001219	3		0.971297	0.001068	1.34041E-09
Centroscymnus owstonii	LC	Large Sharks	2.056717	0.001625	4		1.295062	0.001425	1.78721E-09
Deania profundorum	LC	Large Sharks	0.047	3.71E-05	4		0.029595	3.26E-05	4.08413E-11
Pristis pectinata	CR	Large Sharks	5.141794	0.004062	10	300	3.237655	0.003561	4.46803E-09
Carcharias taurus	VU	Large Sharks	7.198511	0.005687	14	110	4.532717	0.004986	6.25525E-09
Prionace glauca	NT	Large Sharks	8.741049	0.006905	17	170	5.504014	0.006054	7.59566E-09
Hexanchus griseus	NT	Large Sharks	12.85448	0.010155	25	500	8.094138	0.008904	1.11701E-08
Alopias vulpinus	VU	Large Sharks	13.36866	0.010561	26	300	8.417903	0.00926	1.16169E-08

Negaprion brevirostris	NT	Large Sharks	14.39702	0.011373	28	140	9.065434	0.009972	1.25105E-08
Heptranchias perlo	NT	Large Sharks	0.002	1.58E-06	31		0.001259	1.39E-06	1.73793E-12
Carcharhinus obscurus	VU	Large Sharks	94.488	0.074642	39	300	59.49666	0.065446	8.21067E-08
Rhizoprionodon terraenovae	LC	Large Sharks	40.89	0.032302	40	6	25.74738	0.028322	3.55319E-08
Sphyrna tiburo	LC	Large Sharks	0.045	3.55E-05	54	7	0.028335	3.12E-05	3.91034E-11
Alopias superciliosus	VU	Large Sharks	11.1	0.008769	103	300	6.989384	0.007688	9.6455E-09
Carcharhinus plumbeus	VU	Large Sharks	120.028	0.094818	117	90	75.57854	0.083136	1.043E-07
Sphyrna lewini	EN	Large Sharks	4.4	0.003476	153	125	2.770567	0.003048	3.82344E-09
Carcharhinus longimanus	VU	Large Sharks	85.35378	0.067427	166	145	53.74507	0.05912	7.41694E-08
Galeocerdo cuvier	NT	Large Sharks	6.524	0.005154	216	700	4.107995	0.004519	5.66912E-09
Isurus oxyrinchus	VU	Large Sharks	114.1478	0.090173	222	445	71.87594	0.079064	9.91904E-08
Carcharhinus leucas	NT	Large Sharks	1193.407	0.942753	750	280	751.4577	0.826603	1.03703E-06
Carcharhinus falciformis	NT	Large Sharks	19.724	0.015581	1427	300	12.41969	0.013662	1.71394E-08
		Large Sharks	**1755.972**	1.38716	**3450**	**246**	**1105.69**	**1.216259**	**1.52588E-06**
Gymnura micrura	DD	Skates and Rays	0.005	3.95E-06	40	70	3.148371	0.003463	4.34482E-09
Anacanthobatis folirostris / Springeria folirostris	DD	Skates and Rays	0.006	4.74E-06	92		3.778045	0.004156	5.21378E-09
Raja texana / Rostroraja texana	DD	Skates and Rays	0.026	2.05E-05	135		16.37153	0.018009	2.25931E-08
Mobula hypostoma	DD	Skates and Rays	0.096	7.58E-05	9		60.44873	0.066494	8.34206E-08
Dasyatis say / Hypanus say	LC	Skates and Rays	0.454	0.000359			285.8721	0.314459	3.9451E-07
Raja ackleyi /Rostroraja ackleyi	DD	Skates and Rays	0.6	0.000474	1		377.8045	0.415585	5.21378E-07
Anacanthobatis longirostris / Springeria longirostris	DD	Skates and Rays	0.7	0.000553	12		440.772	0.484849	6.08275E-07
Raja eglanteria / Rostroraja eglanteria	LC	Skates and Rays	3.209	0.002535	70		2020.625	2.222687	2.78851E-06
Rhinoptera bonasus	NT	Skates and Rays	150.046	0.118531	224	0.825	94480.1	103.9281	0.000130385
Aetobatus narinari	NT	Skates and Rays	175.674	0.138777		180	110617.4	121.6791	0.000152654
Myliobatis goodei	DD	Skates and Rays	192.997	0.152461			121525.2	133.6778	0.000167707
Dasyatis sabina / Hypanus sabinus	LC	Skates and Rays	452.269	0.357278		4	284782.1	313.2604	0.000393006
Cruriraja poeyi	DD	Skates and Rays		0	0		0	0	0
Pseudoraja fischeri	DD	Skates and Rays		0	0		0	0	0
Dactylobatus armatus	DD	Skates and Rays	0.795993	0.000629	3		501.2164	0.551338	6.9169E-07
Benthobatis marcida	LC	Skates and Rays	1.326655	0.001048	5		835.3606	0.918897	1.15282E-06
Dipturus bullisi	DD	Skates and Rays	1.591986	0.001258	6		1002.433	1.102676	1.38338E-06
Narcine bancroftii	CR	Skates and Rays	1.591986	0.001258	6		1002.433	1.102676	1.38338E-06
Dipturus garricki	DD	Skates and Rays	2.918642	0.002306	11		1837.793	2.021573	2.53619E-06
Dipturus oregoni	DD	Skates and Rays	3.183973	0.002515	12		2004.866	2.205352	2.76676E-06
Rajella purpuriventralis	LC	Skates and Rays	3.449304	0.002725	13		2171.938	2.389131	2.99732E-06
Tetronarce nobiliana	DD	Skates and Rays	3.979966	0.003144	15	70	2506.082	2.75669	3.45845E-06
Dactylobatus clarkii	DD	Skates and Rays	3.979966	0.003144	15		2506.082	2.75669	3.45845E-06
Cruriraja rugosa	DD	Skates and Rays	5.306621	0.004192	20		3341.443	3.675587	4.61126E-06
Dipturus teevani	DD	Skates and Rays	6.102614	0.004821	23		3842.659	4.226925	5.30295E-06
Rajella fuliginea	LC	Skates and Rays	6.367945	0.00503	24		4009.731	4.410704	5.53352E-06
Fenestraja plutonia	DD	Skates and Rays	6.633276	0.00524	25		4176.803	4.594483	5.76408E-06

Leucoraja lentiginosa	DD	Skates and Rays	8.225262	0.006498	31		5179.236	5.69716	7.14746E-06
Dipturus olseni	DD	Skates and Rays	11.67457	0.009223	44		7351.174	8.086291	1.01448E-05
Fenestraja sinusmexicanus	DD	Skates and Rays	39.53433	0.031231	149		24893.75	27.38312	3.43539E-05
Urobatis jamaicensis	LC	Skates and Rays	113.5617	0.08971	428		71506.87	78.65756	9.8681E-05
Dasyatis guttata / Hypanus guttatus	DD	Skates and Rays		0			0	0	0
Himantura schmardae / Styracura schmardae	DD	Skates and Rays		0			0	0	0
		Skates and Rays	**1196.307**	0.945043	**1413**	**64.965**	**753283.6**	**828.6119**	**0.001039548**
Mustelus sinusmexicanus	DD	Small Shark	0.143	0.000113	27		90.04342	0.099048	1.24262E-07
Etmopterus gracilispinis	LC	Small Sharks	3.67	0.002899	12		2310.904	2.541995	3.1891E-06
Etmopterus virens	LC	Small Sharks	4.441	0.003508	159		2796.383	3.076022	3.85907E-06
Etmopterus schultzi	LC	Small Sharks	13.613	0.010754	126		8571.755	9.428931	1.18292E-05
Etmopterus pusillus	LC	Small Sharks	14.252	0.011259	44		8974.117	9.871529	1.23845E-05
Carcharhinus acronotus	NT	Small Sharks	81.32	0.06424	15	13	51205.11	56.32562	7.06642E-05
Carcharhinus isodon	LC	Small Sharks	81.831	0.064644	8		51526.87	56.67956	7.11082E-05
Mustelus norrisi	DD	Small Shark	158.94	0.125557	13	10	100080.4	110.0885	0.000138113
Parmaturus campechiensis	DD	Small Shark	0	0	0		0	0	0
Mustelus higmani	LC	Small Shark	3.546634	0.002802	4		2233.224	2.456546	3.0819E-06
Isistius plutodus	LC	Small Shark	4.433292	0.003502	5		2791.53	3.070683	3.85237E-06
Squalus mitsukurii	DD	Small Shark	7.093267	0.005603	8		4466.448	4.913093	6.1638E-06
Etmopterus bigelowi	LC	Small Sharks	15.95985	0.012608	18		10049.51	11.05446	1.38685E-05
		Small Sharks	**389.243**	0.307489	**439**	**11.5**	**245096.3**	**269.606**	**0.000338238**

APPENDIX D

MARINE MAMMAL SPECIES LIST AND ASSOCIATED DATA

Genus species	Global RL	Functional Group	Northern Estimates	Northern Estimates (OBIS)	Average Adult Weight (kg)	Northern Biomass (kg)	Northern Biomass Estimate (t)	Northern Estimate t/km^2
Trichechus manatus	VU	Manatee	florida stock is estimated to be 5076	11	700	3553200	3908.52	**0.004903**
Balaenoptera edeni	DD	Mysticeti	northern gulf of mexico stock is 33	28	14200	468600	515.46	**0.000647**
Eubalaena glacialis	EN	Mysticeti	entire north atlantic population is estimated to be 451 individuals	9	73000	657000	722.7	**0.000907**
Balaenoptera borealis	EN	Mysticeti	nova scotia stock estimated to be 357 individuals	14	20000	280000	308	**0.000386**
Balaenoptera musculus	EN	Mysticeti	western north atlantic from st. lawrence area is 440	4	180000	720000	792	**0.000994**
Balaenoptera acutorostrata	LC	Mysticeti	best estimate for north canadian atlantic stock is 2591 individuals	14	7500	105000	115.5	**0.000145**
Megaptera novaeangliae	LC	Mysticeti	western atlantic estimates is 896 individuals	11	30000	330000	363	**0.000455**
		Mysticeti		**80**	**324700**	**2560600**	**2816.66**	**0.003534**
Feresa attenuata	DD	Odonticeti	northern gulf of mexico estimate is 152	152	150	22800	25.08	**3.15E-05**
Globicephala macrorhynchus	DD	Odonticeti	western north atlantic estimate is 28,924	39	2200	85800	94.38	**0.000118**
Orcinus orca	DD	Odonticeti	estimate for northern gulf of mexico is 28	35	7000	245000	269.5	**0.000338**
Pseudorca crassidens	DD	Odonticeti	estimate for northern gulf of mexico is from 2003-2004 at 777	36	1450	1126650	1239.315	**0.001555**
Stenella clymene	DD	Odonticeti	estimate for northern gulf of mexico is 129	84	85	10965	12.0615	**1.51E-05**
Stenella frontalis	DD	Odonticeti	nost recent estimate is from fall/spring 2000-2001 at 37611	297	90	26730	29.403	**3.69E-05**

Stenella longirostris	DD	Odonticeti	estimate for northern gulf of mexico is 11441	83	50	572050	629.255	**0.000789**
Kogia breviceps	DD	Odonticeti	estimate for northern gulf of mexico is 186	35	360	66960	73.656	**9.24E-05**
Kogia sima	DD	Odonticeti	estimate for northern gulf of mexico is 186	69	200	37200	40.92	**5.13E-05**
Mesoplodon densirostris	DD	Odonticeti	estimate for northern gulf of mexico is 149	20	900	134100	147.51	**0.000185**
Mesoplodon europaeus	DD	Odonticeti	estimate for northern gulf of mexico is 149	20	1000	149000	163.9	**0.000206**
Grampus griseus	LC	Odonticeti	western north atlantic estimate is 18,250	219	400	87600	96.36	**0.000121**
Lagenodelphis hosei	LC	Odonticeti	best estimates for northern gulf of mexico come from apr-jun of 1996-2001 at 726	23	164	119064	130.9704	**0.000164**
Peponocephala electra	LC	Odonticeti	estimate for northern gulf of mexico is 2235	61	250	558750	614.625	**0.000771**
Stenella attenuata	LC	Odonticeti	estimate for northern gulf of mexico is 50880	601	110	5596800	6156.48	**0.007724**
Stenella coeruleoalba	LC	Odonticeti	estimate for northern gulf of mexico is 1849	79	150	277350	305.085	**0.000383**
Steno bredanensis	LC	Odonticeti	western north atlantic stock estimate is 136	59	130	7670	8.437	**1.06E-05**
Tursiops truncatus	LC	Odonticeti	various stock estimates	6660	400	2664000	2930.4	**0.003676**
Ziphius cavirostris	LC	Odonticeti	estimate for northern gulf of mexico is 74	41	3000	222000	244.2	**0.000306**
Physeter macrocephalus	VU	Odonticeti	estimate for northern gulf of mexico is 763	4357	30000	22890000	25179	**0.031589**
		Odonticeti		**12970**	**48089**	**34900489**	**38390.54**	**0.048163**

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APPENDIX E

MARINE REPTILE SPECIES LIST AND ASSOCIATED DATA

Genus species	Global RL	Fuctional Group	Northern Estimates (OBIS)	Average Adult Weight (kg)	Northern Biomass (kg)	Northern Biomass Estimate (t)	Northern Estimate t/km^2
Crocodylus acutus	VU	Other Reptiles					
Nerodia clarkii	LC	Other Reptiles	1				
Agkistrodon piscivorus	LC	Other Reptiles	1				
Malaclemys terrapin	VU	Other Reptiles	2	0.8	1.6		
Caretta caretta	VU	Sea Turtle	913	135	123255	135.5805	0.00017
Chelonia mydas	EN	Sea Turtle	196	130	25480	28.028	3.52E-05
Eretmochelys imbricata	CR	Sea Turtle	20	80	1600	1.76	2.21E-06
Lepidochelys kempii	CR	Sea Turtle	181	40	7240	7.964	9.99E-06
Dermochelys coriacea	VU	Sea Turtle	795	400	318000	349.8	0.000439
		Sea Turtle	**2105**	**785**	**475575**	**523.1325**	**0.000656**

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APPENDIX F

MARINE INVETEBRATE SPECIES LIST AND ASSOCIATED DATA

Genus species	Global RL	Functional Groups	Northern Estimates (NOAA SEAMAPS [kg])	Weight/Total Area Trawled (km2)	Northern Estimates (OBIS)	Northern Biomass Estimate (t)	Northern Estimate t/km^2
Crassostrea rhizophorae	LC	Bivalves		0.0000	7	0.000000	0
Crassostrea virginica	LC	Bivalves		0.0000	51	0.000000	0
Cryptostrea permollis	DD	Bivalves		0.0000		0.000000	0
Dendostrea cristata	DD	Bivalves		0.0000		0.000000	0
Dendostrea frons	DD	Bivalves		0.0000	77	0.000000	0
Lottia alveus	EX	Bivalves		0.0000		0.000000	0
Ostrea equestris	LC	Bivalves	0.416	0.0003		0.000000	4.53512E-13
ACTINODONTOIDA		Bivalves	0.051	0.0000		0.000000	5.55988E-14
HIATELLA		Bivalves	0.03	0.0000		0.000000	3.27052E-14
HIATELLA ARCTICA		Bivalves	0.001	0.0000		0.000000	1.09017E-15
HIATELLA ARCTICA		Bivalves	920.816	0.7274		0.000800	1.00385E-09
SOLENIDAE		Bivalves	0.164	0.0001		0.000000	1.78788E-13
LEIOMYA HALIMERA		Bivalves	7.664	0.0061		0.000007	8.35508E-12
LYONSIA BEANA		Bivalves	1.833	0.0014		0.000002	1.99829E-12
ANADARA		Bivalves	0.062	0.0000		0.000000	6.75907E-14
ANADARA		Bivalves	18.722	0.0148		0.000016	2.04102E-11
ANADARA BAUGHMANI		Bivalves	117.057	0.0925		0.000102	1.27612E-10
ANADARA BRASILIANA		Bivalves	0.3	0.0002		0.000000	3.27052E-13
ANADARA CHEMNITZI		Bivalves	0.035	0.0000		0.000000	3.8156E-14
ANADARA FLORIDANA		Bivalves	0.056	0.0000		0.000000	6.10496E-14
ANADARA NOTABILIS		Bivalves	0.137	0.0001		0.000000	1.49354E-13
ANADARA OVALIS		Bivalves	3.041	0.0024		0.000003	3.31521E-12
ANADARA TRANSVERSA		Bivalves	4.472	0.0035		0.000004	4.87525E-12
ARCA		Bivalves	0.001	0.0000		0.000000	1.09017E-15
ARCA		Bivalves	2.104	0.0017		0.000002	2.29372E-12
ARCA IMBRICATA		Bivalves	0.509	0.0004		0.000000	5.54898E-13
ARCA ZEBRA		Bivalves	7.738	0.0061		0.000007	8.43575E-12
ARCIDAE		Bivalves	2.073	0.0016		0.000002	2.25993E-12
BARBATIA CANCELLARIA		Bivalves	0.002	0.0000		0.000000	2.18034E-15
BARBATIA CANCELLARIA		Bivalves	0.015	0.0000		0.000000	1.63526E-14
BARBATIA CANDIDA		Bivalves	0.224	0.0002		0.000000	2.44199E-13
BARBATIA DOMINGENSIS		Bivalves	0.003	0.0000		0.000000	3.27052E-15
BARBATIA TENERA		Bivalves	0.022	0.0000		0.000000	2.39838E-14
ACANTHOCARDIA		Bivalves	7.503	0.0059		0.000007	8.17956E-12

AMERICARDIA MEDIA		Bivalves	0.469	0.0004		0.000000	5.11291E-13
CARDIIDAE		Bivalves	1.396	0.0011		0.000001	1.52188E-12
CARDIIDAE		Bivalves	0.102	0.0001		0.000000	1.11198E-13
DINOCARDIUM ROBUSTRUM		Bivalves	0.135	0.0001		0.000000	1.47173E-13
DINODACNA		Bivalves	3.972	0.0031		0.000003	4.33016E-12
LAEVICARDIUM		Bivalves	0.09	0.0001		0.000000	9.81155E-14
LAEVICARDIUM LAEVIGATUM		Bivalves	10.721	0.0085		0.000009	1.16877E-11
LAEVICARDIUM MORTONI		Bivalves	0.061	0.0000		0.000000	6.65005E-14
LAEVICARDIUM PICTUM		Bivalves	2.376	0.0019		0.000002	2.59025E-12
LAEVICARDIUM SYBARITICUM		Bivalves	0.004	0.0000		0.000000	4.36069E-15
NEMOCARDIUM PERAMABILE		Bivalves	0.025	0.0000		0.000000	2.72543E-14
NEMOCARDIUM TINCTUM		Bivalves	0.223	0.0002		0.000000	2.43108E-13
NEMOCARDIUM TRANSVERSUM		Bivalves	0.002	0.0000		0.000000	2.18034E-15
PAPYRIDEA		Bivalves	0.004	0.0000		0.000000	4.36069E-15
PAPYRIDEA SOLENIFORMIS		Bivalves	0.144	0.0001		0.000000	1.56985E-13
		Bivalves	12.73	0.0101		0.000011	1.38779E-11
ABRA AEQUALIS		Bivalves	0.008	0.0000		0.000000	8.72138E-15
SOLECURTUS		Bivalves	0.24	0.0002		0.000000	2.61641E-13
TAGELUS		Bivalves	0.136	0.0001		0.000000	1.48263E-13
TAGELUS PLEBEIUS		Bivalves	0.221	0.0002		0.000000	2.40928E-13
		Bivalves	0.436	0.0003		0.000000	4.75315E-13
MACOMA		Bivalves	515.137	0.4069		0.000448	5.61588E-10
MACOMA BREVIFRONS		Bivalves	1.446	0.0011		0.000001	1.57639E-12
MACOMA CONSTRICTA		Bivalves	0.167	0.0001		0.000000	1.82059E-13
MACOMA MITCHELLI		Bivalves	2.457	0.0019		0.000002	2.67855E-12
MACOMA PULLEYI		Bivalves	0.01	0.0000		0.000000	1.09017E-14
MACOMA TENTA		Bivalves	0.001	0.0000		0.000000	1.09017E-15
STRIGILLA SURINAMENSIS		Bivalves	0.001	0.0000		0.000000	1.09017E-15
TELLINA ALTERNATA		Bivalves	0.004	0.0000		0.000000	4.36069E-15
TELLINA LISTERI		Bivalves	0.001	0.0000		0.000000	1.09017E-15
TELLINA TAMPAENSIS		Bivalves	41.291	0.0326		0.000036	4.50143E-11
TELLINA TENELLA		Bivalves	0.001	0.0000		0.000000	1.09017E-15
TELLINA TEXANA		Bivalves	0.002	0.0000		0.000000	2.18034E-15
TELLINIDAE		Bivalves	0.01	0.0000		0.000000	1.09017E-14
ASTARTE		Bivalves	0.213	0.0002		0.000000	2.32207E-13
ASTARTE GLOBULA		Bivalves	0.408	0.0003		0.000000	4.4479E-13
CARDITA FLORIDANA		Bivalves	5359.493	4.2338		0.004657	5.84277E-09
CARETTA CARETTA		Bivalves	0.006	0.0000		0.000000	6.54103E-15
CRASSINELLA		Bivalves	0.002	0.0000		0.000000	2.18034E-15
CERATOBORNIA		Bivalves	0.286	0.0002		0.000000	3.11789E-13
PARABORNIA SQUILLINA		Bivalves	0.449	0.0004		0.000000	4.89487E-13
SPENGLERIA ROSTRATA		Bivalves	0.029	0.0000		0.000000	3.1615E-14

PANOPEA		Bivalves	0.007	0.0000		0.000000	7.63121E-15
MONOPLEURIDAE		Bivalves	5.08	0.0040		0.000004	5.53807E-12
CTENOIDES		Bivalves	24.693	0.0195		0.000021	2.69196E-11
LIMA		Bivalves	0.008	0.0000		0.000000	8.72138E-15
LIMA PELLUCIDA		Bivalves	0.087	0.0001		0.000000	9.4845E-14
LIMA SCABRA		Bivalves	0.002	0.0000		0.000000	2.18034E-15
LIMARIA		Bivalves	37.818	0.0299		0.000033	4.12281E-11
LIMARIA NODULOSA		Bivalves	0.034	0.0000		0.000000	3.70659E-14
LUCINA		Bivalves	1.726	0.0014		0.000001	1.88164E-12
CORILLIDAE		Bivalves	0.01	0.0000		0.000000	1.09017E-14
VARICORBULA OPERCULATA		Bivalves	0.1	0.0001		0.000000	1.09017E-13
CONGERIA		Bivalves	47.318	0.0374		0.000041	5.15848E-11
PLATYODON		Bivalves	0.085	0.0001		0.000000	9.26646E-14
SPHENIA FRAGILIS		Bivalves	0.469	0.0004		0.000000	5.11291E-13
BARNEA TRUNCATA		Bivalves	0.009	0.0000		0.000000	9.81155E-15
MARTESIA FRAGILIS		Bivalves	0.019	0.0000		0.000000	2.07133E-14
AMYGDALUM DENDRITICUM		Bivalves	0.004	0.0000		0.000000	4.36069E-15
BRACHIDONTES EXUSTUS		Bivalves	0.003	0.0000		0.000000	3.27052E-15
ISCHADIUM RECURVUM		Bivalves	0.022	0.0000		0.000000	2.39838E-14
LITHOPHAGA		Bivalves	0.078	0.0001		0.000000	8.50334E-14
LITHOPHAGA ARISTATA		Bivalves	0.427	0.0003		0.000000	4.65504E-13
MODIOLUS AMERICANUS		Bivalves	0.007	0.0000		0.000000	7.63121E-15
MODIOLUS MODILUS SQUAMOSUS		Bivalves	44.973	0.0355		0.000039	4.90283E-11
MUSCULUS LATERALIS		Bivalves	45.179	0.0357		0.000039	4.92529E-11
MYTILIDONTA		Bivalves	10.025	0.0079		0.000009	1.0929E-11
MYTILIDONTA		Bivalves	0.042	0.0000		0.000000	4.57872E-14
MALLETIA		Bivalves	0.01	0.0000		0.000000	1.09017E-14
LAMELLILEDA		Bivalves	0.3	0.0002		0.000000	3.27052E-13
NUCULANA CONCENTRICA		Bivalves	0.588	0.0005		0.000001	6.41021E-13
MALLEUS CANDEANUS		Bivalves	0.045	0.0000		0.000000	4.90577E-14
OSTREA		Bivalves	0.236	0.0002		0.000000	2.57281E-13
OSTREA FRONS		Bivalves	0.01	0.0000		0.000000	1.09017E-14
OSTREA PERMOLLIS		Bivalves	0.05	0.0000		0.000000	5.45086E-14
OSTREIDAE		Bivalves	20.784	0.0164		0.000018	2.26581E-11
DENDOSTREA		Bivalves	0.007	0.0000		0.000000	7.63121E-15
ABISA		Bivalves	0.097	0.0001		0.000000	1.05747E-13
ANOMIA SIMPLEX		Bivalves	0.004	0.0000		0.000000	4.36069E-15
PODODESMUS RUDIS		Bivalves	0.136	0.0001		0.000000	1.48263E-13
DIMYA ARGENTEA		Bivalves	0.061	0.0000		0.000000	6.65005E-14
AEQUIPECTEN		Bivalves	0.028	0.0000		0.000000	3.05248E-14
AEQUIPECTEN		Bivalves	14.621	0.0116		0.000013	1.59394E-11
AEQUIPECTEN GLYPTUS		Bivalves	125.457	0.0991		0.000109	1.3677E-10

AEQUIPECTEN MUSCOSUS		Bivalves	2.039	0.0016		0.000002	2.22286E-12
AMUSIUM PAPYRACEUM		Bivalves	3289.564	2.5986		0.002859	3.58619E-09
ARGOPECTEN		Bivalves	0.802	0.0006		0.000001	8.74318E-13
ARGOPECTEN GIBBUS		Bivalves	1013.321	0.8005		0.000881	1.10469E-09
ARGOPECTEN IRRADIANS		Bivalves	0.089	0.0001		0.000000	9.70253E-14
CHLAMYS BENEDICTI		Bivalves	0.045	0.0000		0.000000	4.90577E-14
CHLAMYS NANA		Bivalves	0.003	0.0000		0.000000	3.27052E-15
CHLAMYS SENTIS		Bivalves	0.016	0.0000		0.000000	1.74428E-14
EUVOLA		Bivalves	0.554	0.0004		0.000000	6.03955E-13
EUVOLA		Bivalves	0.009	0.0000		0.000000	9.81155E-15
LYROPECTEN NODOSUS		Bivalves	0.005	0.0000		0.000000	5.45086E-15
NODIPECTEN		Bivalves	1.201	0.0009		0.000001	1.3093E-12
PLACOPECTEN MAGELLANICUS		Bivalves	0.009	0.0000		0.000000	9.81155E-15
SPONDYLUS		Bivalves	10.835	0.0086		0.000009	1.1812E-11
SPONDYLUS AMERICANUS		Bivalves	0.96	0.0008		0.000001	1.04657E-12
SPONDYLUS ICTERICUS		Bivalves	95.731	0.0756		0.000083	1.04363E-10
ATRINA		Bivalves	0.594	0.0005		0.000001	6.47562E-13
ATRINA		Bivalves	6.3	0.0050		0.000005	6.86808E-12
ATRINA RIGIDA		Bivalves	20.697	0.0163		0.000018	2.25633E-11
ATRINA SEMINUDA		Bivalves	7.204	0.0057		0.000006	7.8536E-12
ATRINA SERRATA		Bivalves	11.575	0.0091		0.000010	1.26187E-11
PINNA CARNEA		Bivalves	3.824	0.0030		0.000003	4.16882E-12
		Bivalves	0.004	0.0000		0.000000	4.36069E-15
PINCTADA		Bivalves	1.901	0.0015		0.000002	2.07242E-12
PTERIA COLYMBUS		Bivalves	0.136	0.0001		0.000000	1.48263E-13
SOLEMYA		Bivalves	0.001	0.0000		0.000000	1.09017E-15
UNIONOIDA		Bivalves	6710.638	5.3012		0.005831	7.31575E-09
ANATINELLIDAE		Bivalves	0.008	0.0000		0.000000	8.72138E-15
TRACHYCARCINUS MURICATUM		Bivalves	0.002	0.0000		0.000000	2.18034E-15
TRACHYCARCINUS SPINULIFER		Bivalves	0.193	0.0002		0.000000	2.10403E-13
		Bivalves	0.1	0.0001		0.000000	1.09017E-13
ARCINELLA CORNUTA		Bivalves	2.07	0.0016		0.000002	2.25666E-12
CHAMA		Bivalves	0.905	0.0007		0.000001	9.86606E-13
CHAMA CONGREGATA		Bivalves	4.089	0.0032		0.000004	4.45771E-12
CHAMA MACEROPHYLLA		Bivalves	0.007	0.0000		0.000000	7.63121E-15
EUCRASSATELLA SPECIOSA		Bivalves	0.543	0.0004		0.000000	5.91964E-13
MULINIA LATERALIS		Bivalves	0.027	0.0000		0.000000	2.94346E-14
RANGIA FLEXUOSA		Bivalves	0.14	0.0001		0.000000	1.52624E-13
SPISULA SOLIDISSMA		Bivalves	0.445	0.0004		0.000000	4.85127E-13
CORALLIOPHAGA		Bivalves	0.01	0.0000		0.000000	1.09017E-14
CORALLIOPHAGA CORALLIOPHAGA		Bivalves	0.008	0.0000		0.000000	8.72138E-15
CORBULIDAE		Bivalves	40.552	0.0320		0.000035	4.42087E-11

AGRIOPOMA TEXASIANA		Bivalves	5.388	0.0043		0.000005	5.87385E-12
AMIANTIS		Bivalves	0.2	0.0002		0.000000	2.18034E-13
ANOMALOCARDIA		Bivalves	0.045	0.0000		0.000000	4.90577E-14
ANOMALOCARDIA AUBERIANA		Bivalves	0.001	0.0000		0.000000	1.09017E-15
ANTIGONA LISTERI		Bivalves	0.001	0.0000		0.000000	1.09017E-15
CALLISTA EUCYMATA		Bivalves	0.029	0.0000		0.000000	3.1615E-14
CHIONE		Bivalves	0.015	0.0000		0.000000	1.63526E-14
CHIONE CANCELLATA		Bivalves	0.223	0.0002		0.000000	2.43108E-13
CHIONE CLENCHII		Bivalves	0.004	0.0000		0.000000	4.36069E-15
CHIONE INTAPURPUREA		Bivalves	0.108	0.0001		0.000000	1.17739E-13
CHIONE LATILIRATA		Bivalves	14.85	0.0117		0.000013	1.61891E-11
CHIONE PAPHIA		Bivalves	19.588	0.0155		0.000017	2.13543E-11
CIRCOMPHALUS STRIGILLINUS		Bivalves	0.001	0.0000		0.000000	1.09017E-15
GLOBIVENUS RIGIDA		Bivalves	0.109	0.0001		0.000000	1.18829E-13
MACROCALLISTA MACULATA		Bivalves	0.091	0.0001		0.000000	9.92057E-14
MACROCALLISTA NIMBOSA		Bivalves	0.2	0.0002		0.000000	2.18034E-13
MERCENARIA CAMPECHIENSIS		Bivalves	1.494	0.0012		0.000001	1.62872E-12
MERCENARIA MERCENARIA		Bivalves	570.181	0.4504		0.000495	6.21595E-10
PITAR		Bivalves	250.697	0.1980		0.000218	2.73303E-10
PITAR CORDATUS		Bivalves	0.007	0.0000		0.000000	7.63121E-15
PITAR FULMINATUS		Bivalves	0.003	0.0000		0.000000	3.27052E-15
PITAR MORRHUANUS		Bivalves	1.987	0.0016		0.000002	2.16617E-12
VENERIDAE		Bivalves	1.055	0.0008		0.000001	1.15013E-12
VESICOMYA VENUSTA		Bivalves	0.439	0.0003		0.000000	4.78586E-13
		Bivalves	0.596	0.0005		0.000001	6.49743E-13
		Bivalves	0.003	0.0000		0.000000	3.27052E-15
VENTRICOLARIA RIGIDA		Bivalves	0.028	0.0000		0.000000	3.05248E-14
		Bivalves	2.82	0.0022		0.000002	3.07429E-12
BIVALVIA		Bivalves	0.052	0.0000		0.000000	5.6689E-14
		Bivalves	**0.416**		**135**	**0.000000**	**4.53512E-13**
LOLIGINIDAE		Cephalopods	0.016	0.0000		0.000000	1.74428E-14
LOLIGO		Cephalopods	1308.881	1.0340		0.001137	1.42691E-09
LOLIGO PEALEII		Cephalopods	6855.004	5.4152		0.005957	7.47313E-09
LOLIGO PLEII		Cephalopods	0.527	0.0004		0.000000	5.74521E-13
LOLIGO ROPERI		Cephalopods	287.077	0.2268		0.000249	3.12963E-10
LOLIOLUS		Cephalopods	8153.529	6.4410		0.007085	8.88875E-09
LOLLIGUNCULA		Cephalopods	3750.95	2.9631		0.003259	4.08918E-09
LOLLIGUNCULA BREVIS		Cephalopods	0.191	0.0002		0.000000	2.08223E-13
MYOPSIDA		Cephalopods	1.48	0.0012		0.000001	1.61345E-12
NAUTILIDAE		Cephalopods	0.125	0.0001		0.000000	1.36272E-13
OCTOPUS		Cephalopods	2.964	0.0023		0.000003	3.23127E-12

OCTOPUS BRIAREUS		Cephalopods	1.445	0.0011		0.000001	1.5753E-12
OCTOPUS BURRYI		Cephalopods	11.246	0.0089		0.000010	1.22601E-11
OCTOPUS JOUBINI		Cephalopods	0.003	0.0000		0.000000	3.27052E-15
OCTOPUS MACROPUS		Cephalopods	21.774	0.0172		0.000019	2.37374E-11
OCTOPUS VULGARIS		Cephalopods	0.211	0.0002		0.000000	2.30026E-13
		Cephalopods	147.659	0.1166		0.000128	1.60974E-10
CIRROCTOPUS UMBELLATA		Cephalopods	0.014	0.0000		0.000000	1.52624E-14
OCTOPODA		Cephalopods	25.411	0.0201		0.000022	2.77024E-11
OCTOPODA		Cephalopods	1.343	0.0011		0.000001	1.4641E-12
CHIROTEUTHIS HASTULA		Cephalopods	0.007	0.0000		0.000000	7.63121E-15
CHIROTEUTHIS VERANYI		Cephalopods		0.0000		0.000000	0
HISTIOTEUTHIS DOFLEINI		Cephalopods	0.701	0.0006		0.000001	7.64211E-13
LYCOTEUTHIS DIADEMA		Cephalopods	0.003	0.0000		0.000000	3.27052E-15
OMMASTREPHES BARTRAMII		Cephalopods	0.045	0.0000		0.000000	4.90577E-14
ORNITHOTEUTIS		Cephalopods	2536.813	2.0040		0.002204	2.76556E-09
PHOLIDOTEUTHIDAE		Cephalopods	0.008	0.0000		0.000000	8.72138E-15
ROSSIA		Cephalopods	1.473	0.0012		0.000001	1.60582E-12
ROSSIA TORTUGAENSIS		Cephalopods	2.812	0.0022		0.000002	3.06556E-12
SEMIROSSIA		Cephalopods	1.149	0.0009		0.000001	1.25261E-12
SEMIROSSIA		Cephalopods	0.807	0.0006		0.000001	8.79769E-13
SEPIOLIDAE		Cephalopods	0.014	0.0000		0.000000	1.52624E-14
SEPIOLIDAE		Cephalopods	0.004	0.0000		0.000000	4.36069E-15
VAMPYROMORPHA		Cephalopods	0.001	0.0000		0.000000	1.09017E-15
CEPHALOPODA		Cephalopods	8.72	0.0069		0.000008	9.5063E-12
CEPHALOPODA		Cephalopods	0.154	0.0001		0.000000	1.67887E-13
Ancistroteuthis lichtensteini	LC	Cephalopods		0.0000		0.000000	0
Austrorossia antillensis	LC	Cephalopods		0.0000		0.000000	0
Bathothauma lyromma	LC	Cephalopods		0.0000		0.000000	0
Bathyteuthis abyssicola	LC	Cephalopods		0.0000		0.000000	0
Bolitaena pygmaea	LC	Cephalopods		0.0000		0.000000	0
Chiroteuthis joubini	LC	Cephalopods		0.0000		0.000000	0
Chiroteuthis mega	LC	Cephalopods		0.0000		0.000000	0
Cranchia scabra	LC	Cephalopods	0.071	0.0001		0.000000	7.74022E-14
Discoteuthis discus	LC	Cephalopods		0.0000		0.000000	0
Enoploteuthis anapsis	LC	Cephalopods		0.0000		0.000000	0
Haliphron atlanticus	LC	Cephalopods		0.0000		0.000000	0
Helicocranchia papillata	DD	Cephalopods		0.0000		0.000000	0
Histioteuthis corona	LC	Cephalopods		0.0000		0.000000	0
Hyaloteuthis pelagica	LC	Cephalopods		0.0000		0.000000	0
Illex coindetii	LC	Cephalopods	57.714	0.0456		0.000050	6.29182E-11
Illex illecebrosus	LC	Cephalopods	74.015	0.0585		0.000064	8.06891E-11
Illex oxygonius	LC	Cephalopods	0.005	0.0000		0.000000	5.45086E-15

Japetella diaphana	LC	Cephalopods		0.0000		0.000000	0
Joubiniteuthis portieri	LC	Cephalopods		0.0000		0.000000	0
Lampadioteuthis megaleia	LC	Cephalopods		0.0000		0.000000	0
Leachia lemur	DD	Cephalopods		0.0000		0.000000	0
Liocranchia reinhardti	LC	Cephalopods		0.0000		0.000000	0
Magnapinna atlantica	DD	Cephalopods		0.0000		0.000000	0
Magnapinna pacifica	DD	Cephalopods		0.0000		0.000000	0
Mastigoteuthis magna	DD	Cephalopods		0.0000		0.000000	0
Megalocranchia oceanica	DD	Cephalopods		0.0000		0.000000	0
Onychoteuthis banksii	DD	Cephalopods		0.0000		0.000000	0
Onychoteuthis prolata	DD	Cephalopods		0.0000		0.000000	0
Onykia robsoni	LC	Cephalopods		0.0000		0.000000	0
Opisthoteuthis agassizii	DD	Cephalopods	3711.544	2.9320		0.003225	4.04622E-09
Ornithoteuthis antillarum	LC	Cephalopods		0.0000		0.000000	0
Pholidoteuthis adami	LC	Cephalopods	1	0.0008		0.000001	1.09017E-12
Pterygioteuthis giardi	LC	Cephalopods		0.0000		0.000000	0
Rossia bullisi	DD	Cephalopods	2.915	0.0023		0.000003	3.17785E-12
Rossia tortugaensis	DD	Cephalopods		0.0000		0.000000	0
Sandalops melancholicus	DD	Cephalopods		0.0000		0.000000	0
Selenoteuthis scintillans	LC	Cephalopods		0.0000		0.000000	0
Semirossia equalis	DD	Cephalopods	0.024	0.0000		0.000000	2.61641E-14
Semirossia tenera	LC	Cephalopods	0.029	0.0000		0.000000	3.1615E-14
Spirula spirula	LC	Cephalopods		0.0000		0.000000	0
Sthenoteuthis pteropus	LC	Cephalopods		0.0000		0.000000	0
Taningia danae	LC	Cephalopods		0.0000		0.000000	0
Tremoctopus violaceus	LC	Cephalopods		0.0000		0.000000	0
MOLLUSCA		Cephalopods	45.414	0.0359		0.000039	4.95091E-11
MOLLUSCA		Cephalopods	8.286	0.0065		0.000007	9.03317E-12
ABRALIA		Cephalopods	0.305	0.0002		0.000000	3.32503E-13
ABRALIA REDFIELDI		Cephalopods	0.325	0.0003		0.000000	3.54306E-13
ABRALIA VERANYI		Cephalopods	1.573	0.0012		0.000001	1.71484E-12
		Cephalopods	**27025.78**	**21.3495**	**0**	**0.023484**	**2.94628E-08**
ACMAEA		Gastropods	0.002	0.0000		0.000000	2.18034E-15
APLYSIA		Gastropods	42.464	0.0335		0.000037	4.62931E-11
APLYSIA		Gastropods	65.332	0.0516		0.000057	7.12231E-11
APLYSIA BADISTES		Gastropods	0.152	0.0001		0.000000	1.65706E-13
APLYSIA BRASILIANA		Gastropods	13.85	0.0109		0.000012	1.50989E-11
APLYSIA DACTYLOMELA		Gastropods	0.358	0.0003		0.000000	3.90282E-13
APLYSIA MORIO		Gastropods	44.92	0.0355		0.000039	4.89705E-11
APLYSIA WILLCOXI		Gastropods	3.406	0.0027		0.000003	3.71313E-12
APLYSIIDAE		Gastropods	1.27	0.0010		0.000001	1.38452E-12

APLYSIIDAE		Gastropods	0.2	0.0002		0.000000	2.18034E-13
ANASPIDEA		Gastropods	0.001	0.0000		0.000000	1.09017E-15
POMACEA		Gastropods	0.04	0.0000		0.000000	4.36069E-14
CALYPTRAEA		Gastropods	0.029	0.0000		0.000000	3.1615E-14
CASSIS		Gastropods	4.082	0.0032		0.000004	4.45008E-12
CASSIS FLAMMEA		Gastropods	59.351	0.0469		0.000052	6.47028E-11
CASSIS MADAGASCARIENSIS		Gastropods	25.449	0.0201		0.000022	2.77438E-11
CASSIS TUBEROSA		Gastropods	0.689	0.0005		0.000001	7.51129E-13
CERITHIUM		Gastropods	0.024	0.0000		0.000000	2.61641E-14
CERITHIUM ATRATUM		Gastropods	0.002	0.0000		0.000000	2.18034E-15
CERITHIUM EBURNEUM		Gastropods	0.003	0.0000		0.000000	3.27052E-15
CERITHIUM LITERATUM		Gastropods	0.004	0.0000		0.000000	4.36069E-15
AMAEA MITCHELLI		Gastropods	0.013	0.0000		0.000000	1.41722E-14
AMAEA MITCHELLI		Gastropods	0.026	0.0000		0.000000	2.83445E-14
CERITHIDEA		Gastropods	0.245	0.0002		0.000000	2.67092E-13
CERITHIDEA COSTATA		Gastropods	0.003	0.0000		0.000000	3.27052E-15
TURRITELLA ACROPORA		Gastropods	0.05	0.0000		0.000000	5.45086E-14
TURRITELLA EXOLETA		Gastropods	0.003	0.0000		0.000000	3.27052E-15
VERMICULARIA KNORRI		Gastropods	0.002	0.0000		0.000000	2.18034E-15
BULLA		Gastropods	0.1	0.0001		0.000000	1.09017E-13
BULLA ABYSSICOLA		Gastropods	0.046	0.0000		0.000000	5.01479E-14
BULLA STRIATA		Gastropods	0.012	0.0000		0.000000	1.30821E-14
GASTROPTERON		Gastropods	56.41	0.0446		0.000049	6.14966E-11
HAMINOEA ANTILLARUM		Gastropods	0.041	0.0000		0.000000	4.46971E-14
HAMINOEA SUCCINEA		Gastropods	0.001	0.0000		0.000000	1.09017E-15
COCCULINA		Gastropods	0.092	0.0001		0.000000	1.00296E-13
ARCHITECTONICA KREBSI		Gastropods	0.2	0.0002		0.000000	2.18034E-13
ARCHITECTONICA NOBILIS		Gastropods	0.719	0.0006		0.000001	7.83834E-13
ACTEON PUSILLUS		Gastropods	1.241	0.0010		0.000001	1.3529E-12
BURSATELLA LEACHII PLEII		Gastropods	0.002	0.0000		0.000000	2.18034E-15
BURSATELLA LEACHII PLEII		Gastropods	0.019	0.0000		0.000000	2.07133E-14
CAVOLINA TRIDENTATA		Gastropods	0.065	0.0001		0.000000	7.08612E-14
CHILINIDAE		Gastropods	0.045	0.0000		0.000000	4.90577E-14
BULINUS		Gastropods	0.062	0.0000		0.000000	6.75907E-14
DIODORA CAYENENSIS		Gastropods	5.6	0.0044		0.000005	6.10496E-12
ATLANTIDAE		Gastropods	0.045	0.0000		0.000000	4.90577E-14
BURSA GRANALARIS CUBANIANA		Gastropods	0.002	0.0000		0.000000	2.18034E-15
BURSA GRANULARIS		Gastropods	0.768	0.0006		0.000001	8.37252E-13
BURSIDAE		Gastropods	0.647	0.0005		0.000001	7.05341E-13
CAECUM CARPENTERI		Gastropods	11.138	0.0088		0.000010	1.21423E-11
CREPIDULA ACULEATA		Gastropods	0.006	0.0000		0.000000	6.54103E-15
CREPIDULA CONVEXA		Gastropods	0.048	0.0000		0.000000	5.23283E-14

CREPIDULA FORNICATA		Gastropods	0.015	0.0000		0.000000	1.63526E-14
CREPIDULA MACULOSA		Gastropods	0.059	0.0000		0.000000	6.43202E-14
CREPIDULA PLANA		Gastropods	0.029	0.0000		0.000000	3.1615E-14
CRUCIBULUM AURICULA		Gastropods	0.001	0.0000		0.000000	1.09017E-15
CRUCIBULUM STRIATUM		Gastropods	0.1	0.0001		0.000000	1.09017E-13
CARINARIA		Gastropods	0.009	0.0000		0.000000	9.81155E-15
OOCORYS BARTSCHI		Gastropods	1.15	0.0009		0.000001	1.2537E-12
OOCORYS SULCATA		Gastropods	0.024	0.0000		0.000000	2.61641E-14
PHALIUM GRANULATUM		Gastropods	0.1	0.0001		0.000000	1.09017E-13
SCONSIA STRIATA		Gastropods	0.136	0.0001		0.000000	1.48263E-13
		Gastropods	0.012	0.0000		0.000000	1.30821E-14
		Gastropods	18.953	0.0150		0.000016	2.0662E-11
CYMATIUM		Gastropods	0.032	0.0000		0.000000	3.48855E-14
CYMATIUM KREBSII		Gastropods	0.182	0.0001		0.000000	1.98411E-13
CYMATIUM PARTHENOPEUM		Gastropods	0.129	0.0001		0.000000	1.40632E-13
CYMATIUM PILEARE		Gastropods	0.002	0.0000		0.000000	2.18034E-15
CYMATIUM RUBECULUM-OCCIDENTALE		Gastropods	0.004	0.0000		0.000000	4.36069E-15
CYPRAEA		Gastropods	2.445	0.0019		0.000002	2.66547E-12
CYPRAEA		Gastropods	0.016	0.0000		0.000000	1.74428E-14
CYPRAEA CERVUS		Gastropods	0.05	0.0000		0.000000	5.45086E-14
CYPRAEA CINERA		Gastropods	0.181	0.0001		0.000000	1.97321E-13
CYPRAEA SPURCA		Gastropods	0.255	0.0002		0.000000	2.77994E-13
CYPRAEIDAE		Gastropods	0.032	0.0000		0.000000	3.48855E-14
NISO AEGLEES		Gastropods	3.525	0.0028		0.000003	3.84286E-12
FICUS		Gastropods	0.848	0.0007		0.000001	9.24466E-13
FICUS ATLANTICUS		Gastropods	7.991	0.0063		0.000007	8.71157E-12
FICUS COMMUNIS		Gastropods	0.091	0.0001		0.000000	9.92057E-14
FICUS COMMUNIS		Gastropods	1.993	0.0016		0.000002	2.17271E-12
FICUS PAPYRATIUS		Gastropods	0.001	0.0000		0.000000	1.09017E-15
CHEILA		Gastropods	196.974	0.1556		0.000171	2.14736E-10
LUNATIA HEROS		Gastropods	0.003	0.0000		0.000000	3.27052E-15
NATICA		Gastropods	0.009	0.0000		0.000000	9.81155E-15
NEVERITA		Gastropods	13.363	0.0106		0.000012	1.4568E-11
NEVERITA DUPLICATA		Gastropods	0.29	0.0002		0.000000	3.1615E-13
POLINICES BRUNNEUS		Gastropods	0.027	0.0000		0.000000	2.94346E-14
SINUM MACULATUM		Gastropods	0.658	0.0005		0.000001	7.17333E-13
SINUM PERSPECTIVUM		Gastropods	0.045	0.0000		0.000000	4.90577E-14
STIGMAULAX		Gastropods	0.029	0.0000		0.000000	3.1615E-14
STIGMAULAX		Gastropods	0.011	0.0000		0.000000	1.19919E-14
		Gastropods	28.793	0.0227		0.000025	3.13893E-11
		Gastropods	0.4	0.0003		0.000000	4.36069E-13
CYPHOMA		Gastropods	0.014	0.0000		0.000000	1.52624E-14

CYPHOMA MCGINTYI		Gastropods	0.033	0.0000		0.000000	3.59757E-14
PSEUDOCYPHOMA INTERMEDIUM		Gastropods	0.011	0.0000		0.000000	1.19919E-14
SIMNIA UNIPLICATA		Gastropods	0.139	0.0001		0.000000	1.51534E-13
		Gastropods	0.529	0.0004		0.000000	5.76701E-13
DISTORSIO		Gastropods	58.653	0.0463		0.000051	6.39419E-11
DISTORSIO CLATHRATA		Gastropods	0.359	0.0003		0.000000	3.91372E-13
DISTORSIO CLATHRATA		Gastropods	0.102	0.0001		0.000000	1.11198E-13
DISTORSIO MCGINTYI		Gastropods	0.028	0.0000		0.000000	3.05248E-14
RANELLIDAE		Gastropods	0.001	0.0000		0.000000	1.09017E-15
STROMBUS ALATUS		Gastropods	1.094	0.0009		0.000001	1.19265E-12
STROMBUS COSTATUS		Gastropods	0.021	0.0000		0.000000	2.28936E-14
STROMBUS GALLUS		Gastropods	4.671	0.0037		0.000004	5.09219E-12
STROMBUS GIGAS		Gastropods	1.574	0.0012		0.000001	1.71593E-12
STROMBUS RANINUS		Gastropods	0.007	0.0000		0.000000	7.63121E-15
TONNA GALEA		Gastropods	0.446	0.0004		0.000000	4.86217E-13
TONNA MACULOSA		Gastropods	2.907	0.0023		0.000003	3.16913E-12
		Gastropods	60.512	0.0478		0.000053	6.59685E-11
TRIVIA PEDICULUS		Gastropods	0.066	0.0001		0.000000	7.19514E-14
TUGURIUM CARIBAEUM		Gastropods	8.342	0.0066		0.000007	9.09422E-12
TUGURIUM LONGLEYI		Gastropods	58.927	0.0466		0.000051	6.42406E-11
XENOPHORA		Gastropods	0.417	0.0003		0.000000	4.54602E-13
XENOPHORA CONCHYLIOPHORA		Gastropods	2.389	0.0019		0.000002	2.60442E-12
		Gastropods	4.8	0.0038		0.000004	5.23283E-12
LAMELLARIA LEUCOSPHAERA		Gastropods	0.002	0.0000		0.000000	2.18034E-15
LAMELLARIA PERSPICUA		Gastropods	1.47	0.0012		0.000001	1.60255E-12
MESOGASTROPODA		Gastropods	11.987	0.0095		0.000010	1.30679E-11
BUCCINIDAE		Gastropods	0.924	0.0007		0.000001	1.00732E-12
BUCCINIDAE		Gastropods	0.036	0.0000		0.000000	3.92462E-14
BUCCINULIDAE		Gastropods	8.605	0.0068		0.000007	9.38093E-12
BUSYCON		Gastropods	4.169	0.0033		0.000004	4.54493E-12
BUSYCON		Gastropods	0.091	0.0001		0.000000	9.92057E-14
BUSYCON CANALICULATUM		Gastropods	1.116	0.0009		0.000001	1.21663E-12
BUSYCON CANDELABRUM		Gastropods	0.8	0.0006		0.000001	8.72138E-13
BUSYCON CARICA		Gastropods	0.004	0.0000		0.000000	4.36069E-15
BUSYCON COARCTATUM		Gastropods	11.867	0.0094		0.000010	1.29371E-11
BUSYCON CONTRARUM		Gastropods	3.267	0.0026		0.000003	3.56159E-12
BUSYCON LYONSI		Gastropods	8.219	0.0065		0.000007	8.96013E-12
BUSYCON PERVERSUM		Gastropods	7.089	0.0056		0.000006	7.72823E-12
BUSYCON PLAGOSUS		Gastropods	3.601	0.0028		0.000003	3.92571E-12
BUSYCON PULLEYI		Gastropods	17.242	0.0136		0.000015	1.87967E-11
BUSYCON SINISTRUM		Gastropods	6.513	0.0051		0.000006	7.10029E-12
BUSYCON SPIRATUM		Gastropods	0.004	0.0000		0.000000	4.36069E-15

CANCELLARIA		Gastropods	0.046	0.0000		0.000000	5.01479E-14
CANCELLARIA		Gastropods	0.39	0.0003		0.000000	4.25167E-13
CANCELLARIA RETICULATA		Gastropods	0.116	0.0001		0.000000	1.2646E-13
TRIGONOSTOMA TENERUM		Gastropods	0.27	0.0002		0.000000	2.94346E-13
AMPHISSA		Gastropods	0.045	0.0000		0.000000	4.90577E-14
ANACHIS AVARA		Gastropods	0.004	0.0000		0.000000	4.36069E-15
ANACHIS FLORIDANA		Gastropods	0.001	0.0000		0.000000	1.09017E-15
CONUS		Gastropods	0.029	0.0000		0.000000	3.1615E-14
CONUS AUSTINI		Gastropods	0.313	0.0002		0.000000	3.41224E-13
CONUS CLARKI		Gastropods	1.404	0.0011		0.000001	1.5306E-12
CONUS FOSTERI		Gastropods	0.084	0.0001		0.000000	9.15745E-14
CONUS SOZONI		Gastropods	0.03	0.0000		0.000000	3.27052E-14
CERODRILLIA		Gastropods	0.377	0.0003		0.000000	4.10995E-13
HEILPRINIA TIMESSUS		Gastropods	10.026	0.0079		0.000009	1.09301E-11
LATIRUS		Gastropods	0.008	0.0000		0.000000	8.72138E-15
LATIRUS CARINIFERUS		Gastropods	0.165	0.0001		0.000000	1.79878E-13
LATIRUS INFUNDIBULUM		Gastropods	0.022	0.0000		0.000000	2.39838E-14
LATIRUS MCGINTYI		Gastropods	0.042	0.0000		0.000000	4.57872E-14
PLEUROPLOCA GIGANTEA		Gastropods	0.22	0.0002		0.000000	2.39838E-13
FASCIOLARIA		Gastropods	0.922	0.0007		0.000001	1.00514E-12
FASCIOLARIA		Gastropods	1.418	0.0011		0.000001	1.54586E-12
FASCIOLARIA HUNTERIA		Gastropods	1.064	0.0008		0.000001	1.15994E-12
FASCIOLARIA LILIUM		Gastropods	2.946	0.0023		0.000003	3.21165E-12
FASCIOLARIA PAPILLOSA		Gastropods	2.76	0.0022		0.000002	3.00888E-12
FASCIOLARIA TULIPA		Gastropods	0.001	0.0000		0.000000	1.09017E-15
FUSINUS		Gastropods	1.002	0.0008		0.000001	1.09235E-12
FUSINUS COUEI		Gastropods	0.016	0.0000		0.000000	1.74428E-14
FUSINUS EUCOSMIUS		Gastropods	1.175	0.0009		0.000001	1.28095E-12
FUSINUS HELENAE		Gastropods	70.133	0.0554		0.000061	7.6457E-11
FUSINUS VITREUS		Gastropods	0.408	0.0003		0.000000	4.4479E-13
MANGELIA		Gastropods	105.154	0.0831		0.000091	1.14636E-10
MELONGENA		Gastropods	7.511	0.0059		0.000007	8.18828E-12
TURRIS		Gastropods	0.001	0.0000		0.000000	1.09017E-15
CALOTROPHON OSTREARUM		Gastropods	0.235	0.0002		0.000000	2.5619E-13
CHICOREUS		Gastropods	0.43	0.0003		0.000000	4.68774E-13
CHICOREUS FLORIFER-DILECTUS		Gastropods	1.855	0.0015		0.000002	2.02227E-12
FAVARITA CELLULOSA		Gastropods	94.335	0.0745		0.000082	1.02841E-10
MUREX		Gastropods	0.004	0.0000		0.000000	4.36069E-15
MUREX BELLEGLADEENSIS		Gastropods	1.281	0.0010		0.000001	1.39651E-12
MUREX BURRYI		Gastropods	0.087	0.0001		0.000000	9.4845E-14
MUREX CABRITTI		Gastropods	0.024	0.0000		0.000000	2.61641E-14
MUREX CELLULOSUS		Gastropods	0.101	0.0001		0.000000	1.10107E-13

MUREX DONMOOREI		Gastropods	0.012	0.0000		0.000000	1.30821E-14
MUREX FLORIFER DILECTUS		Gastropods	1.364	0.0011		0.000001	1.48699E-12
MUREX HILDALGOI		Gastropods	15.529	0.0123		0.000013	1.69293E-11
MUREX LEVICULUS		Gastropods	0.04	0.0000		0.000000	4.36069E-14
MUREX TYRONI		Gastropods	16.94	0.0134		0.000015	1.84675E-11
MURICANTHUS FULVESCENS		Gastropods	0.005	0.0000		0.000000	5.45086E-15
MURICEA		Gastropods	0.27	0.0002		0.000000	2.94346E-13
MURICEA PENDULA		Gastropods	0.045	0.0000		0.000000	4.90577E-14
MURICIDAE		Gastropods	0.116	0.0001		0.000000	1.2646E-13
MURICIDAE		Gastropods	0.004	0.0000		0.000000	4.36069E-15
MURICOPSIS HEXAGONA		Gastropods	0.005	0.0000		0.000000	5.45086E-15
PHYLLONOTUM POMUM		Gastropods	87.15	0.0688		0.000076	9.50085E-11
SIRATUS BEAUII		Gastropods	0.002	0.0000		0.000000	2.18034E-15
THAIS		Gastropods	3.184	0.0025		0.000003	3.47111E-12
THAIS HAEMASTOMA		Gastropods	0.111	0.0001		0.000000	1.21009E-13
UROSALPINX CINEREA		Gastropods	0.005	0.0000		0.000000	5.45086E-15
UROSALPINX PERRUGATA		Gastropods	0.015	0.0000		0.000000	1.63526E-14
		Gastropods	0.01	0.0000		0.000000	1.09017E-14
		Gastropods	0.118	0.0001		0.000000	1.2864E-13
		Gastropods	0.295	0.0002		0.000000	3.21601E-13
		Gastropods	2	0.0016		0.000002	2.18034E-12
HYALINA TORTICULA		Gastropods	0.01	0.0000		0.000000	1.09017E-14
ANTILLOPHOS		Gastropods	0.002	0.0000		0.000000	2.18034E-15
ANTILLOPHOS CANDEI		Gastropods	0.008	0.0000		0.000000	8.72138E-15
OLIVA FULGURATOR		Gastropods	0.055	0.0000		0.000000	5.99595E-14
OLIVA RETICULARIS		Gastropods	4.832	0.0038		0.000004	5.26771E-12
OLIVA SAYANA		Gastropods	0.005	0.0000		0.000000	5.45086E-15
OLIVA SCRIPTA		Gastropods	0.045	0.0000		0.000000	4.90577E-14
OLIVIDAE		Gastropods	0.045	0.0000		0.000000	4.90577E-14
CANTHARUS		Gastropods	3.191	0.0025		0.000003	3.47874E-12
CANTHARUS		Gastropods	0.001	0.0000		0.000000	1.09017E-15
CANTHARUS CANCELLARIUS		Gastropods	0.131	0.0001		0.000000	1.42813E-13
CANTHARUS TINCTUS		Gastropods	0.4	0.0003		0.000000	4.36069E-13
ENGINA TURBINELLA		Gastropods	0.015	0.0000		0.000000	1.63526E-14
PISANIA TINCTA		Gastropods	0.003	0.0000		0.000000	3.27052E-15
PISIDIIDAE		Gastropods	0.188	0.0001		0.000000	2.04952E-13
LEUCOSYRINX SUBGRUNDIFERA		Gastropods	86.897	0.0686		0.000076	9.47327E-11
PLEUROTOMELLA EXPANSA		Gastropods	0.255	0.0002		0.000000	2.77994E-13
TEREBRA DISLOCATA		Gastropods	0.045	0.0000		0.000000	4.90577E-14
TEREBRA SALLEANA		Gastropods	3.254	0.0026		0.000003	3.54742E-12
COLUMBARIUM		Gastropods	1.118	0.0009		0.000001	1.21881E-12
TURBINELLA		Gastropods	0.015	0.0000		0.000000	1.63526E-14

COMPSODRILLA TRILIDEATA		Gastropods	0.055	0.0000		0.000000	5.99595E-14
COMPSODRILLA TRISTICHA		Gastropods	1	0.0008		0.000001	1.09017E-12
POLYSTIRA		Gastropods	50.848	0.0402		0.000044	5.54331E-11
POLYSTIRA ALBIDA		Gastropods	12.832	0.0101		0.000011	1.39891E-11
POLYSTIRA TELLEA		Gastropods	0.037	0.0000		0.000000	4.03364E-14
TURRIDAE		Gastropods	0.267	0.0002		0.000000	2.91076E-13
TURRIDAE		Gastropods	0.642	0.0005		0.000001	6.99891E-13
		Gastropods	470.407	0.3716		0.000409	5.12825E-10
AURINIOPSIS		Gastropods	0.3	0.0002		0.000000	3.27052E-13
SCAPHELLA		Gastropods	3.5	0.0028		0.000003	3.8156E-12
SCAPHELLA ATLANTIS		Gastropods	0.114	0.0001		0.000000	1.2428E-13
SCAPHELLA DOHRNI		Gastropods	10.13	0.0080		0.000009	1.10434E-11
SCAPHELLA DUBIA		Gastropods	0.344	0.0003		0.000000	3.75019E-13
SCAPHELLA JUNONIA		Gastropods	0.261	0.0002		0.000000	2.84535E-13
SCAPHELLA KIENERI		Gastropods	91.581	0.0723		0.000080	9.98391E-11
SCAPHELLA ROBUSTA		Gastropods	0.005	0.0000		0.000000	5.45086E-15
NEOGASTROPODA		Gastropods	0.258	0.0002		0.000000	2.81264E-13
NEOGASTROPODA		Gastropods	0.613	0.0005		0.000001	6.68276E-13
CINGULA		Gastropods	0.095	0.0001		0.000000	1.03566E-13
CINGULA FLORIDANA		Gastropods	1.577	0.0012		0.000001	1.7192E-12
FELIMARE		Gastropods	0.135	0.0001		0.000000	1.47173E-13
GLOSSODORIS		Gastropods	0.006	0.0000		0.000000	6.54103E-15
GLYCYMERIDIDAE		Gastropods	0.05	0.0000		0.000000	5.45086E-14
HYPSELODORIS		Gastropods	0.124	0.0001		0.000000	1.35181E-13
HYPSELODORIS EDENTICULATA		Gastropods	0.036	0.0000		0.000000	3.92462E-14
DISCODORIS		Gastropods	0.001	0.0000		0.000000	1.09017E-15
AUSTRAEOLIS		Gastropods	12.36	0.0098		0.000011	1.34745E-11
GLAUCUS ATLANTICUS		Gastropods	0.037	0.0000		0.000000	4.03364E-14
LOMANOTIDAE		Gastropods	0.003	0.0000		0.000000	3.27052E-15
POLYCERA		Gastropods	0.007	0.0000		0.000000	7.63121E-15
POLYCERA HERTHAE		Gastropods	0.17	0.0001		0.000000	1.85329E-13
SCYLLAEA		Gastropods	0.001	0.0000		0.000000	1.09017E-15
SCYLLAEA PELAGICA		Gastropods	0.128	0.0001		0.000000	1.39542E-13
TRITONIA		Gastropods	0.001	0.0000		0.000000	1.09017E-15
CHROMODORIDAE		Gastropods	1344.124	1.0618		0.001168	1.46533E-09
NUDIBRANCHIA		Gastropods	12.339	0.0097		0.000011	1.34516E-11
NUDIBRANCHIA		Gastropods	0.052	0.0000		0.000000	5.6689E-14
NOTASPIDEA		Gastropods	0.001	0.0000		0.000000	1.09017E-15
LEPETIDAE		Gastropods	0.065	0.0001		0.000000	7.08612E-14
PLEUROBRANCHUS		Gastropods	0.012	0.0000		0.000000	1.30821E-14
PLEUROBRANCHUS HEDGPETHI		Gastropods	0.019	0.0000		0.000000	2.07133E-14
BRASILISSA ALTA		Gastropods	0.193	0.0002		0.000000	2.10403E-13

HELMINTHOGLYPTIDAE		Gastropods	0.004	0.0000		0.000000	4.36069E-15
SIPHONARIA HENICA		Gastropods	0.075	0.0001		0.000000	8.17629E-14
ACHATINIDAE		Gastropods	0.004	0.0000		0.000000	4.36069E-15
HELIX		Gastropods	4.141	0.0033		0.000004	4.5144E-12
TROCHUS		Gastropods	0.405	0.0003		0.000000	4.4152E-13
TROCHIDAE		Gastropods	0.01	0.0000		0.000000	1.09017E-14
TURBINIDAE		Gastropods	0.014	0.0000		0.000000	1.52624E-14
TURBO		Gastropods	0.305	0.0002		0.000000	3.32503E-13
TURBO CASTANEUS		Gastropods	0.002	0.0000		0.000000	2.18034E-15
UMBRACULUM		Gastropods	0.52	0.0004		0.000000	5.6689E-13
UMBRACULUM PLICATULUM		Gastropods	12.242	0.0097		0.000011	1.33459E-11
CALLIOSTOMA		Gastropods	0.005	0.0000		0.000000	5.45086E-15
CALLIOSTOMA BULLISI		Gastropods	0.031	0.0000		0.000000	3.37953E-14
CALLIOSTOMA EUGLYPTUM		Gastropods	0.045	0.0000		0.000000	4.90577E-14
CALLIOSTOMA JUJUBINUM		Gastropods	0.014	0.0000		0.000000	1.52624E-14
HOMALOPOMA ALBIDA		Gastropods	1.346	0.0011		0.000001	1.46737E-12
NESTA		Gastropods	6.589	0.0052		0.000006	7.18314E-12
NESTA ATLANTICA		Gastropods	0.786	0.0006		0.000001	8.56875E-13
ARMINA		Gastropods	0.011	0.0000		0.000000	1.19919E-14
ARMINA MULLERI		Gastropods	0.027	0.0000		0.000000	2.94346E-14
ARMINA TIGRINA		Gastropods	0.026	0.0000		0.000000	2.83445E-14
FISSURELLA		Gastropods	1	0.0008		0.000001	1.09017E-12
GAZA SUPERBA		Gastropods	100	0.0790		0.000087	1.09017E-10
GABRIELONA SULCIFERA		Gastropods	0.074	0.0001		0.000000	8.06727E-14
ELYSIA		Gastropods	0.018	0.0000		0.000000	1.96231E-14
Cerithidea pliculosa	LC	Gastropods		0.0000		0.000000	0
Conus amphiurgus	LC	Gastropods	7.526	0.0059		0.000007	8.20464E-12
Conus anabathrum	VU	Gastropods		0.0000		0.000000	0
Conus arangoi	LC	Gastropods		0.0000		0.000000	0
Conus armiger	LC	Gastropods		0.0000		0.000000	0
Conus attenuatus	LC	Gastropods		0.0000		0.000000	0
Conus cancellatus	LC	Gastropods	0.106	0.0001		0.000000	1.15558E-13
Conus daucus	LC	Gastropods	0.428	0.0003		0.000000	4.66594E-13
Conus delessertii	LC	Gastropods		0.0000		0.000000	0
Conus ermineus	LC	Gastropods		0.0000		0.000000	0
Conus flavescens	LC	Gastropods		0.0000		0.000000	0
Conus granulatus	LC	Gastropods		0.0000		0.000000	0
Conus havanensis	LC	Gastropods		0.0000		0.000000	0
Conus mazei	LC	Gastropods	0.024	0.0000		0.000000	2.61641E-14
Conus mcgintyi	LC	Gastropods		0.0000		0.000000	0
Conus mindanus	LC	Gastropods		0.0000		0.000000	0
Conus mus	LC	Gastropods		0.0000		0.000000	0

Conus patae	LC	Gastropods		0.0000		0.000000	0
Conus pealii	LC	Gastropods		0.0000		0.000000	0
Conus rainesae	LC	Gastropods		0.0000		0.000000	0
Conus regius	LC	Gastropods		0.0000		0.000000	0
Conus sauros	DD	Gastropods		0.0000		0.000000	0
Conus sennottorum	LC	Gastropods		0.0000		0.000000	0
Conus spurius	LC	Gastropods	1.383	0.0011		0.000001	1.50771E-12
Conus stearnsii	VU	Gastropods		0.0000		0.000000	0
Conus stimpsoni	LC	Gastropods	0.149	0.0001		0.000000	1.62436E-13
Conus villepinii	LC	Gastropods		0.0000		0.000000	0
Heleobops docima	LC	Gastropods		0.0000		0.000000	0
Littoridinops palustris	LC	Gastropods		0.0000		0.000000	0
Melampus coffeus	LC	Gastropods		0.0000		0.000000	0
		Gastropods	**3597.524**	**2.8419**	**0**	**0.003126**	**3.92192E-09**
Limulus polyphemus	VU	Horseshoe Crab	0.102	0.0001		0.000000	1.11198E-13
		Horseshoe Crab	**0.102**	**0.0001**	**0**	**0.000000**	**1.11198E-13**
Acanthacaris caeca	LC	Lobster / Shrimp		0.0000		0.000000	0
Bathyarctus faxoni	LC	Lobster / Shrimp		0.0000		0.000000	0
Cardus crucifer	LC	Lobster / Shrimp		0.0000		0.000000	0
Eunephrops cadenasi	LC	Lobster / Shrimp		0.0000		0.000000	0
Metanephrops binghami	LC	Lobster / Shrimp		0.0000		0.000000	0
Nephropsis aculeata	LC	Lobster / Shrimp		0.0000		0.000000	0
Nephropsis agassizii	LC	Lobster / Shrimp		0.0000		0.000000	0
Nephropsis rosea	LC	Lobster / Shrimp	0.003	0.0000		0.000000	3.27052E-15
Panulirus argus	DD	Lobster / Shrimp	0.005	0.0000		0.000000	5.45086E-15
Pentacheles laevis	LC	Lobster / Shrimp		0.0000		0.000000	0
Polycheles perarmatus	LC	Lobster / Shrimp		0.0000		0.000000	0
Polycheles typhlops	LC	Lobster / Shrimp	2420.527	1.9121		0.002103	2.63879E-09
Scyllarides aequinoctialis	LC	Lobster / Shrimp	0.1	0.0001		0.000000	1.09017E-13
Scyllarides nodifer	LC	Lobster / Shrimp	10.188	0.0080		0.000009	1.11067E-11
Scyllarus americanus	LC	Lobster / Shrimp	18.165	0.0143		0.000016	1.9803E-11
Scyllarus chacei	LC	Lobster / Shrimp	1.411	0.0011		0.000001	1.53823E-12
Scyllarus depressus	LC	Lobster / Shrimp	417.398	0.3297		0.000363	4.55036E-10
Scyllarus planorbis	DD	Lobster / Shrimp		0.0000		0.000000	0
Stereomastis sculpta	LC	Lobster / Shrimp		0.0000		0.000000	0
Thaumastocheles zaleucus	LC	Lobster / Shrimp		0.0000		0.000000	0

Willemoesia forceps	LC	Lobster / Shrimp		0.0000		0.000000	0
COLLODES		Lobster / Shrimp	0.016	0.0000		0.000000	1.74428E-14
COLLODES LEPTOCHELES		Lobster / Shrimp	1.45	0.0011		0.000001	1.58075E-12
COLLODES ROBUSTUS		Lobster / Shrimp	0.039	0.0000		0.000000	4.25167E-14
COLLODES TRISPINOSUS		Lobster / Shrimp	0.045	0.0000		0.000000	4.90577E-14
COELOCERUS SPINOSUS		Lobster / Shrimp	0.024	0.0000		0.000000	2.61641E-14
CIRRIPEDIA		Lobster / Shrimp	5.454	0.0043		0.000005	5.9458E-12
SCALPELLUM		Lobster / Shrimp	8.211	0.0065		0.000007	8.9514E-12
SCALPELLUM GIGANTEUM		Lobster / Shrimp	45.37	0.0358		0.000039	4.94611E-11
		Lobster / Shrimp	0.002	0.0000		0.000000	2.18034E-15
HYDROPHILIDAE		Lobster / Shrimp	57.582	0.0455		0.000050	6.27743E-11
CHORISTIDAE		Lobster / Shrimp	0.084	0.0001		0.000000	9.15745E-14
COENAGRIDAE		Lobster / Shrimp	1.867	0.0015		0.000002	2.03535E-12
OXYCEPHALIDAE		Lobster / Shrimp	0.004	0.0000		0.000000	4.36069E-15
SCINIDAE		Lobster / Shrimp	66.083	0.0522		0.000057	7.20419E-11
HEPATUS EPHELITICUS		Lobster / Shrimp	4.347	0.0034		0.000004	4.73898E-12
HEPATUS PRINCEPS		Lobster / Shrimp	0.064	0.0001		0.000000	6.9771E-14
HEPATUS PUDIBUNDUS		Lobster / Shrimp	3.127	0.0025		0.000003	3.40897E-12
OSACHILA SEMILEVIS		Lobster / Shrimp	0.004	0.0000		0.000000	4.36069E-15
OSACHILA TUBEROSA		Lobster / Shrimp	0.002	0.0000		0.000000	2.18034E-15
ALBUNEA GIBBESII		Lobster / Shrimp	0.023	0.0000		0.000000	2.5074E-14
ALBUNEA PARETII		Lobster / Shrimp	0.143	0.0001		0.000000	1.55895E-13
LEPIDOPA		Lobster / Shrimp	0.001	0.0000		0.000000	1.09017E-15
LEPIDOPA BENEDICTI		Lobster / Shrimp	1.547	0.0012		0.000001	1.6865E-12
LEPIDOPA WEBSTERI		Lobster / Shrimp	129.858	0.1026		0.000113	1.41568E-10
ALPHEIDAE		Lobster / Shrimp	0.023	0.0000		0.000000	2.5074E-14
ALPHEUS		Lobster / Shrimp	0.561	0.0004		0.000000	6.11587E-13
ALPHEUS		Lobster / Shrimp	0.075	0.0001		0.000000	8.17629E-14
ALPHEUS ARMATUS		Lobster / Shrimp	0.004	0.0000		0.000000	4.36069E-15
ALPHEUS FLORIDANUS		Lobster / Shrimp	0.591	0.0005		0.000001	6.44292E-13
ALPHEUS FORMOSUS		Lobster / Shrimp	0.064	0.0001		0.000000	6.9771E-14
ALPHEUS HETEROCHELIS		Lobster / Shrimp	0.024	0.0000		0.000000	2.61641E-14
ALPHEUS NORMANNI		Lobster / Shrimp	0.012	0.0000		0.000000	1.30821E-14
SYNALPHEUS		Lobster / Shrimp	0.02	0.0000		0.000000	2.18034E-14
SYNALPHEUS FRITZMUELLERI		Lobster / Shrimp	0.064	0.0001		0.000000	6.9771E-14
SYNALPHEUS LONGICARPUS		Lobster / Shrimp	0.007	0.0000		0.000000	7.63121E-15

SYNALPHEUS MINUS		Lobster / Shrimp	0.03	0.0000		0.000000	3.27052E-14
SYNALPHEUS TOWNSENDI		Lobster / Shrimp	16.366	0.0129		0.000014	1.78418E-11
ANCHISTIOIDES ANTIGUENSIS		Lobster / Shrimp	0.006	0.0000		0.000000	6.54103E-15
ARISTAEOMORPHA FOLIACEA		Lobster / Shrimp	7.521	0.0059		0.000007	8.19919E-12
ARISTEUS ANTILLENSIS		Lobster / Shrimp	68.053	0.0538		0.000059	7.41895E-11
HEPOMADUS		Lobster / Shrimp	0.125	0.0001		0.000000	1.36272E-13
PLESIOPENAEUS EDWARDSIANUS		Lobster / Shrimp	5.576	0.0044		0.000005	6.0788E-12
AXIANASSA ARENARIA		Lobster / Shrimp	0.1	0.0001		0.000000	1.09017E-13
AXIIDAE		Lobster / Shrimp	0.002	0.0000		0.000000	2.18034E-15
AXIIDAE		Lobster / Shrimp	0.14	0.0001		0.000000	1.52624E-13
AXIOPSIS		Lobster / Shrimp	0.002	0.0000		0.000000	2.18034E-15
AXIOPSIS		Lobster / Shrimp	0.003	0.0000		0.000000	3.27052E-15
AXIOPSIS HIRSUTIMANA		Lobster / Shrimp	0.104	0.0001		0.000000	1.13378E-13
CALOCARIS HIRSUTIMANA		Lobster / Shrimp	0.004	0.0000		0.000000	4.36069E-15
ACANTHOCARPUS ALEXANDRI		Lobster / Shrimp	11.015	0.0087		0.000010	1.20082E-11
CALAPPA		Lobster / Shrimp	0.005	0.0000		0.000000	5.45086E-15
CALAPPA		Lobster / Shrimp	0.012	0.0000		0.000000	1.30821E-14
CALAPPA ANGUSTA		Lobster / Shrimp	2.033	0.0016		0.000002	2.21632E-12
CALAPPA CINERE		Lobster / Shrimp	117.867	0.0931		0.000102	1.28495E-10
CALAPPA FLAMMEA		Lobster / Shrimp	0.197	0.0002		0.000000	2.14764E-13
CALAPPA GALLUS		Lobster / Shrimp	0.409	0.0003		0.000000	4.4588E-13
CALAPPA OCELLATA		Lobster / Shrimp	3058.67	2.4162		0.002658	3.33448E-09
CALAPPA SULCATA		Lobster / Shrimp	0.042	0.0000		0.000000	4.57872E-14
CALAPPA TORTUGAE		Lobster / Shrimp	0.014	0.0000		0.000000	1.52624E-14
CALAPPIDAE		Lobster / Shrimp	1.542	0.0012		0.000001	1.68105E-12
CYCLOES BAIRDII		Lobster / Shrimp	0.002	0.0000		0.000000	2.18034E-15
GLYPTURUS		Lobster / Shrimp	0.005	0.0000		0.000000	5.45086E-15
GLYPTURUS ACANTHOCHIRUS		Lobster / Shrimp	0.126	0.0001		0.000000	1.37362E-13
GLYPTURUS ACANTHOCHIRUS		Lobster / Shrimp	55.821	0.0441		0.000049	6.08545E-11
PROCAMBARUS CLARKII		Lobster / Shrimp	0.016	0.0000		0.000000	1.74428E-14
CHASMOCARCINUS MISSISSIPPIENSIS		Lobster / Shrimp	0.045	0.0000		0.000000	4.90577E-14
CHIROSTYLUS SPINIFER		Lobster / Shrimp	0.191	0.0002		0.000000	2.08223E-13
UROPTYCHUS UNCIFER		Lobster / Shrimp	0.046	0.0000		0.000000	5.01479E-14
PONTOCARIS		Lobster / Shrimp	0.003	0.0000		0.000000	3.27052E-15
PONTOPHILUS GRACILIS		Lobster / Shrimp	0.018	0.0000		0.000000	1.96231E-14
CLIBANARIUS VITTATUS		Lobster / Shrimp	0.002	0.0000		0.000000	2.18034E-15

DARDANUS		Lobster / Shrimp	1.069	0.0008		0.000001	1.16539E-12
DARDANUS		Lobster / Shrimp	1.524	0.0012		0.000001	1.66142E-12
DARDANUS FUCOSUS		Lobster / Shrimp	12.566	0.0099		0.000011	1.36991E-11
DARDANUS INSIGNIS		Lobster / Shrimp	0.008	0.0000		0.000000	8.72138E-15
DARDANUS SINISTRIPES		Lobster / Shrimp	0.686	0.0005		0.000001	7.47858E-13
DIOGENIDAE		Lobster / Shrimp	0.162	0.0001		0.000000	1.76608E-13
DIOGENIDAE		Lobster / Shrimp	0.138	0.0001		0.000000	1.50444E-13
ISOCHELES WURDEMANNI		Lobster / Shrimp	0.628	0.0005		0.000001	6.84628E-13
PAGURISTES		Lobster / Shrimp	0.027	0.0000		0.000000	2.94346E-14
PAGURISTES HUMMI		Lobster / Shrimp	0.033	0.0000		0.000000	3.59757E-14
PAGURISTES LYMANI		Lobster / Shrimp	0.012	0.0000		0.000000	1.30821E-14
PAGURISTES OXYOPHTHALMUS		Lobster / Shrimp	0.037	0.0000		0.000000	4.03364E-14
PAGURISTES SERICEUS		Lobster / Shrimp	0.168	0.0001		0.000000	1.83149E-13
PAGURISTES TORTUGAE		Lobster / Shrimp	4.827	0.0038		0.000004	5.26226E-12
PAGURISTES TRIANGULATUS		Lobster / Shrimp	0.018	0.0000		0.000000	1.96231E-14
PETROCHIRUS		Lobster / Shrimp	68.76	0.0543		0.000060	7.49602E-11
PETROCHIRUS DIOGENES		Lobster / Shrimp	0.016	0.0000		0.000000	1.74428E-14
		Lobster / Shrimp	6.426	0.0051		0.000006	7.00545E-12
DROMIA		Lobster / Shrimp	0.2	0.0002		0.000000	2.18034E-13
DROMIA ERYTHROPUS		Lobster / Shrimp	0.034	0.0000		0.000000	3.70659E-14
DROMIDIA		Lobster / Shrimp	8.026	0.0063		0.000007	8.74972E-12
DROMIDIA ANTILLENSIS		Lobster / Shrimp	0.52	0.0004		0.000000	5.6689E-13
DROMIDIA ANTILLENSIS		Lobster / Shrimp	0.051	0.0000		0.000000	5.55988E-14
DROMIIDAE		Lobster / Shrimp	0.286	0.0002		0.000000	3.11789E-13
DROMIIDAE		Lobster / Shrimp	14.112	0.0111		0.000012	1.53845E-11
HYPOCONCHA		Lobster / Shrimp	0.014	0.0000		0.000000	1.52624E-14
HYPOCONCHA ARCUATA		Lobster / Shrimp	0.096	0.0001		0.000000	1.04657E-13
HYPOCONCHA SABULOSA		Lobster / Shrimp	1.363	0.0011		0.000001	1.4859E-12
LIBINIA DUBIA		Lobster / Shrimp	354.538	0.2801		0.000308	3.86507E-10
LIBINIA EMARGINATA		Lobster / Shrimp	42.647	0.0337		0.000037	4.64926E-11
MACROCOELOMA		Lobster / Shrimp	0.366	0.0003		0.000000	3.99003E-13
MACROCOELOMA CAMPTOCERUM		Lobster / Shrimp	0.06	0.0000		0.000000	6.54103E-14
MACROCOELOMA EUTHECA		Lobster / Shrimp	0.045	0.0000		0.000000	4.90577E-14
MACROCOELOMA NODIPES		Lobster / Shrimp	2.636	0.0021		0.000002	2.87369E-12
MACROCOELOMA TRISPINOSUM		Lobster / Shrimp	0.019	0.0000		0.000000	2.07133E-14
NIBILIA ANTILOCAPRA		Lobster / Shrimp	0.101	0.0001		0.000000	1.10107E-13

ROCHINIA CRASSA		Lobster / Shrimp	0.045	0.0000		0.000000	4.90577E-14
ROCHINIA HYSTRIX		Lobster / Shrimp	0.136	0.0001		0.000000	1.48263E-13
ROCHINIA TANNERI		Lobster / Shrimp	0.005	0.0000		0.000000	5.45086E-15
TYCHE		Lobster / Shrimp	0.108	0.0001		0.000000	1.17739E-13
TYCHE EMARGINATA		Lobster / Shrimp	0.002	0.0000		0.000000	2.18034E-15
		Lobster / Shrimp	0.028	0.0000		0.000000	3.05248E-14
		Lobster / Shrimp	133.64	0.1056		0.000116	1.45691E-10
ERIPHIA		Lobster / Shrimp	0.117	0.0001		0.000000	1.2755E-13
ETHUSA		Lobster / Shrimp	2.63	0.0021		0.000002	2.86715E-12
ETHUSA TENUIPES		Lobster / Shrimp	0.338	0.0003		0.000000	3.68478E-13
ETHUSINA ABYSSICOLA		Lobster / Shrimp	1.079	0.0009		0.000001	1.1763E-12
EURYPLAX		Lobster / Shrimp	0.003	0.0000		0.000000	3.27052E-15
FREVILLEA		Lobster / Shrimp	0.004	0.0000		0.000000	4.36069E-15
FREVILLEA HIRSUTA		Lobster / Shrimp	0.001	0.0000		0.000000	1.09017E-15
GALATHEA		Lobster / Shrimp	0.467	0.0004		0.000000	5.0911E-13
GALATHEA		Lobster / Shrimp	0.064	0.0001		0.000000	6.9771E-14
GALATHEA ROSTRATA		Lobster / Shrimp	27.408	0.0217		0.000024	2.98794E-11
GERYON AFFINIS		Lobster / Shrimp	0.227	0.0002		0.000000	2.47469E-13
GERYON QUINQUEDENS		Lobster / Shrimp	0.1	0.0001		0.000000	1.09017E-13
GERYON QUINQUEDENS		Lobster / Shrimp	225.261	0.1779		0.000196	2.45573E-10
RAYMANNINUS SCHMITTI		Lobster / Shrimp	0.59	0.0005		0.000001	6.43202E-13
GLYPHOCRANGON ACULEATA		Lobster / Shrimp	2.789	0.0022		0.000002	3.04049E-12
GLYPHOCRANGON LONGIROSTRIS		Lobster / Shrimp	0.861	0.0007		0.000001	9.38638E-13
GLYPHOCRANGON LONGLEYI		Lobster / Shrimp	0.045	0.0000		0.000000	4.90577E-14
GLYPHOCRANGON NEGLECTA		Lobster / Shrimp	0.285	0.0002		0.000000	3.10699E-13
GLYPHOCRANGON SPINICAUDA		Lobster / Shrimp	0.003	0.0000		0.000000	3.27052E-15
BATHYPLAX TYPHLA		Lobster / Shrimp	5.9	0.0047		0.000005	6.43202E-12
GONEPLAX		Lobster / Shrimp	0.775	0.0006		0.000001	8.44883E-13
GONEPLAX HIRSUTA		Lobster / Shrimp	0.04	0.0000		0.000000	4.36069E-14
PLANES MINUTUS		Lobster / Shrimp	0.045	0.0000		0.000000	4.90577E-14
HIPPOLYTIDAE		Lobster / Shrimp	0.003	0.0000		0.000000	3.27052E-15
LATREUTES FUCORUM		Lobster / Shrimp	0.011	0.0000		0.000000	1.19919E-14
LATREUTES PARVULUS		Lobster / Shrimp	0.038	0.0000		0.000000	4.14265E-14
LYSMATA		Lobster / Shrimp	0.002	0.0000		0.000000	2.18034E-15
LYSMATA		Lobster / Shrimp	0.118	0.0001		0.000000	1.2864E-13
LYSMATA WURDEMANNI		Lobster / Shrimp	0.1	0.0001		0.000000	1.09017E-13

THOR		Lobster / Shrimp	8.709	0.0069		0.000008	9.49431E-12
TOZEUMA SERRATUM		Lobster / Shrimp	0.001	0.0000		0.000000	1.09017E-15
HOMOLA BARBATA		Lobster / Shrimp	0.002	0.0000		0.000000	2.18034E-15
HOMOLIDAE		Lobster / Shrimp	10.042	0.0079		0.000009	1.09475E-11
INACHIDAE		Lobster / Shrimp	0.001	0.0000		0.000000	1.09017E-15
METOPORHAPHIS CALCARATA		Lobster / Shrimp	0.087	0.0001		0.000000	9.4845E-14
PODOCHELA		Lobster / Shrimp	0.049	0.0000		0.000000	5.34184E-14
PODOCHELA GRACILIPES		Lobster / Shrimp	0.151	0.0001		0.000000	1.64616E-13
PODOCHELA LAMELLIGERA		Lobster / Shrimp	1.35	0.0011		0.000001	1.47173E-12
PODOCHELA RIISEI		Lobster / Shrimp	4.447	0.0035		0.000004	4.848E-12
PODOCHELA SIDNEYI		Lobster / Shrimp	0.057	0.0000		0.000000	6.21398E-14
STENORHYNCHUS		Lobster / Shrimp	470.993	0.3721		0.000409	5.13463E-10
STENORHYNCHUS SETICORNIS		Lobster / Shrimp	0.209	0.0002		0.000000	2.27846E-13
		Lobster / Shrimp	0.001	0.0000		0.000000	1.09017E-15
		Lobster / Shrimp	0.088	0.0001		0.000000	9.59352E-14
		Lobster / Shrimp	0.002	0.0000		0.000000	2.18034E-15
ANASIMUS		Lobster / Shrimp	0.231	0.0002		0.000000	2.5183E-13
ANASIMUS LATUS		Lobster / Shrimp	712.356	0.5627		0.000619	7.76591E-10
ARACHNOPSIS FILIPES		Lobster / Shrimp	0.048	0.0000		0.000000	5.23283E-14
INACHOIDES FORCEPS		Lobster / Shrimp	0.001	0.0000		0.000000	1.09017E-15
PYROMAIA ARACHNA		Lobster / Shrimp	0.723	0.0006		0.000001	7.88195E-13
PYROMAIA CUSPIDATA		Lobster / Shrimp	0.273	0.0002		0.000000	2.97617E-13
		Lobster / Shrimp	0.859	0.0007		0.000001	9.36458E-13
LATREILLIA MANNINGI		Lobster / Shrimp	0.003	0.0000		0.000000	3.27052E-15
ILIACANTHA		Lobster / Shrimp	0.654	0.0005		0.000001	7.12973E-13
ILIACANTHA LIODACTYLUS		Lobster / Shrimp	0.045	0.0000		0.000000	4.90577E-14
ILIACANTHA SPARSA		Lobster / Shrimp	0.127	0.0001		0.000000	1.38452E-13
ILIACANTHA SUBGLOBOSA		Lobster / Shrimp	128.644	0.1016		0.000112	1.40244E-10
CALLIDACTYLUS ASPER		Lobster / Shrimp	0.58	0.0005		0.000001	6.323E-13
LEUCOSIIDAE		Lobster / Shrimp	0.238	0.0002		0.000000	2.59461E-13
MYROPHIS		Lobster / Shrimp	0.092	0.0001		0.000000	1.00296E-13
MYROPSIS		Lobster / Shrimp	13.867	0.0110		0.000012	1.51174E-11
MYROPSIS QUINQUESPINOSA		Lobster / Shrimp	0.002	0.0000		0.000000	2.18034E-15
PERSEPHONA		Lobster / Shrimp	60.771	0.0480		0.000053	6.62509E-11
PERSEPHONA CRINITA		Lobster / Shrimp	12.216	0.0097		0.000011	1.33175E-11
PERSEPHONA MEDITERRANEA		Lobster / Shrimp	1.413	0.0011		0.000001	1.54041E-12

NEOLITHODES AGASSIZII		Lobster / Shrimp	0.269	0.0002		0.000000	2.93256E-13
EXHIPPOLYSMATA OPLOPHOROIDES		Lobster / Shrimp	0.038	0.0000		0.000000	4.14265E-14
MAJIDAE		Lobster / Shrimp	9.742	0.0077		0.000008	1.06205E-11
MAJIDAE		Lobster / Shrimp	3.691	0.0029		0.000003	4.02383E-12
MENIPPE ADINA		Lobster / Shrimp	0.388	0.0003		0.000000	4.22987E-13
MENIPPE MERCENARIA		Lobster / Shrimp	3603.201	2.8464		0.003131	3.92811E-09
		Lobster / Shrimp	6.867	0.0054		0.000006	7.48621E-12
MITHRAX		Lobster / Shrimp	0.415	0.0003		0.000000	4.52421E-13
MITHRAX ACUTICORNIS		Lobster / Shrimp	0.323	0.0003		0.000000	3.52126E-13
MITHRAX FORCEPS		Lobster / Shrimp	1.745	0.0014		0.000002	1.90235E-12
MITHRAX HISPIDUS		Lobster / Shrimp	0.014	0.0000		0.000000	1.52624E-14
MITHRAX PLEURACANTHUS		Lobster / Shrimp	0.225	0.0002		0.000000	2.45289E-13
PITHO		Lobster / Shrimp	0.009	0.0000		0.000000	9.81155E-15
PITHO ANISODON		Lobster / Shrimp	0.045	0.0000		0.000000	4.90577E-14
STENOCIONOPS		Lobster / Shrimp	4.751	0.0038		0.000004	5.17941E-12
STENOCIONOPS COELATA		Lobster / Shrimp	32.404	0.0256		0.000028	3.53259E-11
STENOCIONOPS FURCATA		Lobster / Shrimp	46.451	0.0367		0.000040	5.06396E-11
STENOCIONOPS SPINIMANA		Lobster / Shrimp	25.403	0.0201		0.000022	2.76936E-11
STENOCIONOPS SPINOSISSIMA		Lobster / Shrimp	1.972	0.0016		0.000002	2.14982E-12
		Lobster / Shrimp	1.036	0.0008		0.000001	1.12942E-12
		Lobster / Shrimp	0.066	0.0001		0.000000	7.19514E-14
MUNIDA		Lobster / Shrimp	0.102	0.0001		0.000000	1.11198E-13
MUNIDA FLINTI		Lobster / Shrimp	40.631	0.0321		0.000035	4.42948E-11
MUNIDA FORCEPS		Lobster / Shrimp	0.002	0.0000		0.000000	2.18034E-15
MUNIDA IRIS		Lobster / Shrimp	0.113	0.0001		0.000000	1.23189E-13
MUNIDA IRRASA		Lobster / Shrimp	0.575	0.0005		0.000000	6.26849E-13
MUNIDA LONGIPES		Lobster / Shrimp	2.614	0.0021		0.000002	2.84971E-12
MUNIDA PUSILLA		Lobster / Shrimp	0.092	0.0001		0.000000	1.00296E-13
MUNIDA ROBUSTA		Lobster / Shrimp	0.136	0.0001		0.000000	1.48263E-13
MUNIDA SIMPLEX		Lobster / Shrimp	0.02	0.0000		0.000000	2.18034E-14
MUNIDA VALIDA		Lobster / Shrimp	2.389	0.0019		0.000002	2.60442E-12
		Lobster / Shrimp	6.379	0.0050		0.000006	6.95421E-12
MUNIDOPSIS LIVIDA		Lobster / Shrimp	1.303	0.0010		0.000001	1.42049E-12
MUNIDOPSIS ROBUSTA		Lobster / Shrimp	4.247	0.0034		0.000004	4.62996E-12
NEMATOCARCINUS CURSOR		Lobster / Shrimp	0.973	0.0008		0.000001	1.06074E-12
NEMATOCARCINUS ENSIFER		Lobster / Shrimp	1.355	0.0011		0.000001	1.47718E-12

		Lobster / Shrimp	0.002	0.0000		0.000000	2.18034E-15
NEOPHOBERUS CAECUS		Lobster / Shrimp	6.8	0.0054		0.000006	7.41317E-12
NEPHROPSIS		Lobster / Shrimp	20.482	0.0162		0.000018	2.23289E-11
NEPHROPSIS AGASSIZII		Lobster / Shrimp	0.09	0.0001		0.000000	9.81155E-14
OCYPODE		Lobster / Shrimp	0.03	0.0000		0.000000	3.27052E-14
OCYPODE QUADRATA		Lobster / Shrimp	50.582	0.0400		0.000044	5.51431E-11
OPLOPHORUS GRACILIROSTRIS		Lobster / Shrimp	1.193	0.0009		0.000001	1.30058E-12
OPLOPHORUS SPINICAUDA		Lobster / Shrimp	0.046	0.0000		0.000000	5.01479E-14
SYSTELLASPIS PELLUCIDA		Lobster / Shrimp	0.059	0.0000		0.000000	6.43202E-14
		Lobster / Shrimp	0.09	0.0001		0.000000	9.81155E-14
IRIDOPAGURUS		Lobster / Shrimp	0.007	0.0000		0.000000	7.63121E-15
MANUCOMPLANUS		Lobster / Shrimp	0.053	0.0000		0.000000	5.77791E-14
MANUCOMPLANUS CORALLINUS		Lobster / Shrimp	0.196	0.0002		0.000000	2.13674E-13
MANUCOMPLANUS UNGULATUS		Lobster / Shrimp	0.01	0.0000		0.000000	1.09017E-14
PAGURIDAE		Lobster / Shrimp	24.815	0.0196		0.000022	2.70526E-11
PAGURIDAE		Lobster / Shrimp	0.459	0.0004		0.000000	5.00389E-13
PAGURUS		Lobster / Shrimp	0.248	0.0002		0.000000	2.70363E-13
PAGURUS ANNULIPES		Lobster / Shrimp	0.069	0.0001		0.000000	7.52219E-14
PAGURUS BREVIDACTYLUS		Lobster / Shrimp	3.391	0.0027		0.000003	3.69677E-12
PAGURUS BULLISI		Lobster / Shrimp	0.01	0.0000		0.000000	1.09017E-14
PAGURUS CAROLINENSIS		Lobster / Shrimp	0.004	0.0000		0.000000	4.36069E-15
PAGURUS DEFENSUS		Lobster / Shrimp	0.154	0.0001		0.000000	1.67887E-13
PAGURUS IMPRESSUS		Lobster / Shrimp	0.275	0.0002		0.000000	2.99797E-13
PAGURUS LONGICARPUS		Lobster / Shrimp	0.035	0.0000		0.000000	3.8156E-14
PAGURUS LONGIMANUS		Lobster / Shrimp	6.545	0.0052		0.000006	7.13518E-12
PAGURUS POLLICARIS		Lobster / Shrimp	0.004	0.0000		0.000000	4.36069E-15
PHIMOCHIRUS		Lobster / Shrimp	0.113	0.0001		0.000000	1.23189E-13
PHIMOCHIRUS HOLTHUISI		Lobster / Shrimp	125.021	0.0988		0.000109	1.36294E-10
PYLOPAGURUS HISPIDUS		Lobster / Shrimp	0.02	0.0000		0.000000	2.18034E-14
		Lobster / Shrimp	21.025	0.0166		0.000018	2.29209E-11
LEANDER TENUICORNIS		Lobster / Shrimp	0.016	0.0000		0.000000	1.74428E-14
MACROBRACHIUM ACANTHURUS		Lobster / Shrimp	0.05	0.0000		0.000000	5.45086E-14
MACROBRACHIUM OHIONE		Lobster / Shrimp	0.005	0.0000		0.000000	5.45086E-15
PALAEMON		Lobster / Shrimp	0.043	0.0000		0.000000	4.68774E-14
PALAEMONETES VULGARIS		Lobster / Shrimp	0.037	0.0000		0.000000	4.03364E-14
PERICLIMENES		Lobster / Shrimp	0.002	0.0000		0.000000	2.18034E-15

PERICLIMENES AMERICANUS		Lobster / Shrimp	0.005	0.0000		0.000000	5.45086E-15
		Lobster / Shrimp	0.049	0.0000		0.000000	5.34184E-14
		Lobster / Shrimp	0.055	0.0000		0.000000	5.99595E-14
		Lobster / Shrimp	0.007	0.0000		0.000000	7.63121E-15
PALICIDAE		Lobster / Shrimp	0.131	0.0001		0.000000	1.42813E-13
PALICIDAE		Lobster / Shrimp	0.012	0.0000		0.000000	1.30821E-14
PALICUS		Lobster / Shrimp	0.012	0.0000		0.000000	1.30821E-14
PALICUS AFFINIS		Lobster / Shrimp	0.167	0.0001		0.000000	1.82059E-13
PALICUS ALTERNATA		Lobster / Shrimp	0.08	0.0001		0.000000	8.72138E-14
PALICUS FAXONI		Lobster / Shrimp	0.016	0.0000		0.000000	1.74428E-14
PALICUS OBESA		Lobster / Shrimp	0.01	0.0000		0.000000	1.09017E-14
		Lobster / Shrimp	0.001	0.0000		0.000000	1.09017E-15
HETEROCARPUS ENSIFER		Lobster / Shrimp	0.01	0.0000		0.000000	1.09017E-14
PARAPANDALUS		Lobster / Shrimp	0.002	0.0000		0.000000	2.18034E-15
PLESIONIKA		Lobster / Shrimp	0.001	0.0000		0.000000	1.09017E-15
PLESIONIKA ACANTHONOTUS		Lobster / Shrimp	0.701	0.0006		0.000001	7.64211E-13
PLESIONIKA EDWARDSII		Lobster / Shrimp	0.102	0.0001		0.000000	1.11198E-13
PLESIONIKA ENSIS		Lobster / Shrimp	3.389	0.0027		0.000003	3.69459E-12
PLESIONIKA LONGICAUDA		Lobster / Shrimp	0.053	0.0000		0.000000	5.77791E-14
PLESIONIKA LONGIPES		Lobster / Shrimp	3.21	0.0025		0.000003	3.49945E-12
PLESIONIKA MACROPODA		Lobster / Shrimp	0.005	0.0000		0.000000	5.45086E-15
PLESIONIKA TENUIPES		Lobster / Shrimp	1.604	0.0013		0.000001	1.74864E-12
DYSPANOPEUS SAYI		Lobster / Shrimp	20.756	0.0164		0.000018	2.26276E-11
EURYPANOPEUS ABBREVIATUS		Lobster / Shrimp	0.004	0.0000		0.000000	4.36069E-15
EURYPANOPEUS ABBREVIATUS		Lobster / Shrimp	0.008	0.0000		0.000000	8.72138E-15
EURYPANOPEUS DEPRESSUS		Lobster / Shrimp	0.007	0.0000		0.000000	7.63121E-15
EURYTIUM LIMOSUM		Lobster / Shrimp	9.713	0.0077		0.000008	1.05888E-11
GLYPTOPLAX SMITHII		Lobster / Shrimp	0.942	0.0007		0.000001	1.02694E-12
LOPHOPANOPEUS DISTINCTUS		Lobster / Shrimp	0.544	0.0004		0.000000	5.93054E-13
NEOPANOPE		Lobster / Shrimp	0.003	0.0000		0.000000	3.27052E-15
NEOPANOPE TEXANA		Lobster / Shrimp	6.045	0.0048		0.000005	6.59009E-12
PANOPEUS BERMUDENSIS		Lobster / Shrimp	0.015	0.0000		0.000000	1.63526E-14
PANOPEUS HERBSTII		Lobster / Shrimp	0.009	0.0000		0.000000	9.81155E-15
PANOPEUS OCCIDENTALIS		Lobster / Shrimp	0.071	0.0001		0.000000	7.74022E-14
PANOPEUS SIMPSONI		Lobster / Shrimp	0.001	0.0000		0.000000	1.09017E-15
PANOPEUS TURGIDUS		Lobster / Shrimp	34.362	0.0271		0.000030	3.74605E-11

RHITHROPANOPEUS HARRISII		Lobster / Shrimp	5202.859	4.1101		0.004521	5.67201E-09
		Lobster / Shrimp	0.13	0.0001		0.000000	1.41722E-13
PARAPAGURUS PILOSIMANUS		Lobster / Shrimp	0.4	0.0003		0.000000	4.36069E-13
HETEROCRYPTA GRANULATA		Lobster / Shrimp	0.226	0.0002		0.000000	2.46379E-13
HEXAPANOPEUS		Lobster / Shrimp	0.059	0.0000		0.000000	6.43202E-14
HEXAPANOPEUS PAULENSIS		Lobster / Shrimp	0.12	0.0001		0.000000	1.30821E-13
HEXAPANOPEUS PAULENSIS		Lobster / Shrimp	0.017	0.0000		0.000000	1.85329E-14
LEIOLAMBRUS		Lobster / Shrimp	0.203	0.0002		0.000000	2.21305E-13
LEIOLAMBRUS GRANULOSUS		Lobster / Shrimp	0.009	0.0000		0.000000	9.81155E-15
LEIOLAMBRUS NITIDUS		Lobster / Shrimp	57630.51	45.5262		0.050079	6.28272E-08
SOLENOLAMBRUS TENELLUS		Lobster / Shrimp	0.181	0.0001		0.000000	1.97321E-13
LEPTOCHELA		Lobster / Shrimp	0.025	0.0000		0.000000	2.72543E-14
LEPTOCHELA		Lobster / Shrimp	2.321	0.0018		0.000002	2.53029E-12
FUNCHALIA VILLOSA		Lobster / Shrimp	0.008	0.0000		0.000000	8.72138E-15
METAPENAEOPSIS		Lobster / Shrimp	13.314	0.0105		0.000012	1.45146E-11
METAPENAEOPSIS GOODEI		Lobster / Shrimp	0.045	0.0000		0.000000	4.90577E-14
METAPENAEOPSIS SMITHI		Lobster / Shrimp	1.687	0.0013		0.000001	1.83912E-12
PARAPENAEUS		Lobster / Shrimp	0.009	0.0000		0.000000	9.81155E-15
PARAPENAEUS AMERICANUS		Lobster / Shrimp	216.671	0.1712		0.000188	2.36209E-10
PARAPENAEUS POLITUS		Lobster / Shrimp	2.505	0.0020		0.000002	2.73088E-12
TRACHYPENEOPSIS		Lobster / Shrimp	1393.706	1.1010		0.001211	1.51938E-09
TRACHYPENEUS		Lobster / Shrimp	4152.945	3.2807		0.003609	4.52743E-09
TRACHYPENEUS		Lobster / Shrimp	4.403	0.0035		0.000004	4.80003E-12
TRACHYPENEUS SIMILIS		Lobster / Shrimp	4882.569	3.8571		0.004243	5.32284E-09
XIPHOPENAEUS KROYERI		Lobster / Shrimp	2.134	0.0017		0.000002	2.32643E-12
		Lobster / Shrimp	525.924	0.4155		0.000457	5.73348E-10
		Lobster / Shrimp	0.062	0.0000		0.000000	6.75907E-14
DANIELUM IXBAUCHAC		Lobster / Shrimp	0.008	0.0000		0.000000	8.72138E-15
LOBOPILUMNUS AGASSIZII		Lobster / Shrimp	10.534	0.0083		0.000009	1.14839E-11
PILUMNUS		Lobster / Shrimp	0.107	0.0001		0.000000	1.16648E-13
PILUMNUS DASYPODUS		Lobster / Shrimp	0.072	0.0001		0.000000	7.84924E-14
PILUMNUS FLORIDANUS		Lobster / Shrimp	0.019	0.0000		0.000000	2.07133E-14
PILUMNUS GRACILIPES		Lobster / Shrimp	0.045	0.0000		0.000000	4.90577E-14
PILUMNUS SAYI		Lobster / Shrimp	0.768	0.0006		0.000001	8.37252E-13
		Lobster / Shrimp	3.18	0.0025		0.000003	3.46675E-12
PINNIXA		Lobster / Shrimp	0.001	0.0000		0.000000	1.09017E-15

PINNIXA CHAETOPTERANA		Lobster / Shrimp	0.016	0.0000		0.000000	1.74428E-14
PINNOTHERES		Lobster / Shrimp	0.01	0.0000		0.000000	1.09017E-14
PINNOTHERES MACULATUS		Lobster / Shrimp	0.095	0.0001		0.000000	1.03566E-13
		Lobster / Shrimp	0.004	0.0000		0.000000	4.36069E-15
EUCHIROGRAPSUS AMERICANUS		Lobster / Shrimp	0.004	0.0000		0.000000	4.36069E-15
PLAGUSIA		Lobster / Shrimp	0.107	0.0001		0.000000	1.16648E-13
PLAGUSIA DEPRESSA		Lobster / Shrimp	0.001	0.0000		0.000000	1.09017E-15
BATHYNECTES LONGISPINA		Lobster / Shrimp	0.129	0.0001		0.000000	1.40632E-13
BATHYNECTES SUPERBA		Lobster / Shrimp	1.973	0.0016		0.000002	2.15091E-12
POLYCHELES SCULPTUS		Lobster / Shrimp	2.577	0.0020		0.000002	2.80937E-12
		Lobster / Shrimp	81.824	0.0646		0.000071	8.92023E-11
EUCERAMUS PRAELONGUS		Lobster / Shrimp	0.067	0.0001		0.000000	7.30415E-14
EUCERAMUS PRAELONGUS		Lobster / Shrimp	0.005	0.0000		0.000000	5.45086E-15
MEGALOBRACHIUM		Lobster / Shrimp	96	0.0758		0.000083	1.04657E-10
PACHYCHELES		Lobster / Shrimp	1.275	0.0010		0.000001	1.38997E-12
PACHYCHELES ACKLEIANUS		Lobster / Shrimp	0.009	0.0000		0.000000	9.81155E-15
PACHYCHELES RUGIMANUS		Lobster / Shrimp	0.003	0.0000		0.000000	3.27052E-15
PETROLISTHES		Lobster / Shrimp	0.144	0.0001		0.000000	1.56985E-13
PETROLISTHES ARMATUS		Lobster / Shrimp	6.287	0.0050		0.000005	6.85391E-12
PETROLISTHES GALATHINUS		Lobster / Shrimp	15.968	0.0126		0.000014	1.74079E-11
PORCELLANA		Lobster / Shrimp	3.254	0.0026		0.000003	3.54742E-12
PORCELLANA		Lobster / Shrimp	2.366	0.0019		0.000002	2.57935E-12
PORCELLANA SAYANA		Lobster / Shrimp	1.623	0.0013		0.000001	1.76935E-12
PORCELLANA SIGSBEIANA		Lobster / Shrimp	1866.751	1.4747		0.001622	2.03508E-09
ARENAEUS CRIBRARIUS		Lobster / Shrimp	139.967	0.1106		0.000122	1.52588E-10
CALLINECTES		Lobster / Shrimp	4.525	0.0036		0.000004	4.93303E-12
CALLINECTES		Lobster / Shrimp	0.132	0.0001		0.000000	1.43903E-13
CALLINECTES DANAE		Lobster / Shrimp	1.16	0.0009		0.000001	1.2646E-12
CALLINECTES ORNATUS		Lobster / Shrimp	3140.868	2.4812		0.002729	3.42409E-09
CALLINECTES SAPIDUS		Lobster / Shrimp	16777.79	13.2539		0.014579	1.82907E-08
CALLINECTES SIMILIS		Lobster / Shrimp	2.266	0.0018		0.000002	2.47033E-12
CRONIUS RUBER		Lobster / Shrimp	0.036	0.0000		0.000000	3.92462E-14
OVALIPES FLORIDANUS		Lobster / Shrimp	1.79	0.0014		0.000002	1.95141E-12
OVALIPES OCELLATUS		Lobster / Shrimp	12.366	0.0098		0.000011	1.34811E-11
OVALIPES STEPHENSONI		Lobster / Shrimp	0.1	0.0001		0.000000	1.09017E-13
PORTUNIDAE		Lobster / Shrimp	18.524	0.0146		0.000016	2.01944E-11

PORTUNIDAE		Lobster / Shrimp	0.66	0.0005		0.000001	7.19514E-13
PORTUNUS		Lobster / Shrimp	0.149	0.0001		0.000000	1.62436E-13
PORTUNUS		Lobster / Shrimp	15.701	0.0124		0.000014	1.71168E-11
PORTUNUS ANCEPS		Lobster / Shrimp	3.04	0.0024		0.000003	3.31412E-12
PORTUNUS DEPRESSIFRONS		Lobster / Shrimp	0.382	0.0003		0.000000	4.16446E-13
PORTUNUS FLORIDANUS		Lobster / Shrimp	1962.494	1.5503		0.001705	2.13946E-09
PORTUNUS GIBBESII		Lobster / Shrimp	16.116	0.0127		0.000014	1.75692E-11
PORTUNUS ORDWAYII		Lobster / Shrimp	6.847	0.0054		0.000006	7.46441E-12
PORTUNUS SAYI		Lobster / Shrimp	4194.116	3.3132		0.003645	4.57231E-09
PORTUNUS SPINICARPUS		Lobster / Shrimp	1034.583	0.8173		0.000899	1.12787E-09
PORTUNUS SPINIMANUS		Lobster / Shrimp	0.006	0.0000		0.000000	6.54103E-15
PORTUNUS VENTRALIS		Lobster / Shrimp	505.131	0.3990		0.000439	5.5068E-10
		Lobster / Shrimp	22.486	0.0178		0.000020	2.45136E-11
NIKOIDES SCHMITTI		Lobster / Shrimp	0.001	0.0000		0.000000	1.09017E-15
PROCESSA		Lobster / Shrimp	0.002	0.0000		0.000000	2.18034E-15
PROCESSA PROFUNDA		Lobster / Shrimp	0.001	0.0000		0.000000	1.09017E-15
PROCESSA TENUIPES		Lobster / Shrimp	0.068	0.0001		0.000000	7.41317E-14
PSALIDOPUS BARBOURI		Lobster / Shrimp	0.002	0.0000		0.000000	2.18034E-15
EUPHROSYNOPLAX		Lobster / Shrimp	4.572	0.0036		0.000004	4.98427E-12
EUPHROSYNOPLAX CLAUSA		Lobster / Shrimp	1.206	0.0010		0.000001	1.31475E-12
NANOPLAX XANTHIFORMIS		Lobster / Shrimp	0.225	0.0002		0.000000	2.45289E-13
PSEUDORHOMBILA QUADRIDENTATA		Lobster / Shrimp	0.001	0.0000		0.000000	1.09017E-15
SPEOCARCINUS CAROLINENSIS		Lobster / Shrimp	4.419	0.0035		0.000004	4.81747E-12
SPEOCARCINUS LOBATUS		Lobster / Shrimp	2.186	0.0017		0.000002	2.38312E-12
TETRAXANTHUS BIDENTATUS		Lobster / Shrimp	0.192	0.0002		0.000000	2.09313E-13
TETRAXANTHUS RATHBUNAE		Lobster / Shrimp	3.406	0.0027		0.000003	3.71313E-12
		Lobster / Shrimp	27.5	0.0217		0.000024	2.99797E-11
		Lobster / Shrimp	0.114	0.0001		0.000000	1.2428E-13
LYREIDUS BAIRDII		Lobster / Shrimp	0.019	0.0000		0.000000	2.07133E-14
LYREIDUS NITIDUS		Lobster / Shrimp	3.376	0.0027		0.000003	3.68042E-12
RANILIA		Lobster / Shrimp	0.339	0.0003		0.000000	3.69568E-13
RANILIA MURICATA		Lobster / Shrimp	0.122	0.0001		0.000000	1.33001E-13
RANINIDAE		Lobster / Shrimp	0.031	0.0000		0.000000	3.37953E-14
RANINOIDES		Lobster / Shrimp	1.547	0.0012		0.000001	1.6865E-12
RANINOIDES LOEVIS		Lobster / Shrimp	602.015	0.4756		0.000523	6.563E-10
RANINOIDES LOUISIANENSIS		Lobster / Shrimp	1.567	0.0012		0.000001	1.7083E-12

		Lobster / Shrimp	540.301	0.4268		0.000470	5.89021E-10
SCYLLARIDES		Lobster / Shrimp	0.568	0.0004		0.000000	6.19218E-13
SCYLLARUS FAXONI		Lobster / Shrimp	105.626	0.0834		0.000092	1.15151E-10
ACETES AMERICANUS		Lobster / Shrimp	1.226	0.0010		0.000001	1.33655E-12
ACETES CAROLINAE		Lobster / Shrimp	0.003	0.0000		0.000000	3.27052E-15
SERGESTES		Lobster / Shrimp	0.01	0.0000		0.000000	1.09017E-14
SERGIA ROBUSTA		Lobster / Shrimp	0.397	0.0003		0.000000	4.32798E-13
SESARMA		Lobster / Shrimp	2.215	0.0017		0.000002	2.41473E-12
SICYONIA		Lobster / Shrimp	5093.317	4.0236		0.004426	5.55259E-09
SICYONIA BREVIROSTRIS		Lobster / Shrimp	4.621	0.0037		0.000004	5.03769E-12
SICYONIA BURKENROADI		Lobster / Shrimp	830.719	0.6562		0.000722	9.05627E-10
SICYONIA DORSALIS		Lobster / Shrimp	1.439	0.0011		0.000001	1.56876E-12
SICYONIA LAEVIGATA		Lobster / Shrimp	1.411	0.0011		0.000001	1.53823E-12
SICYONIA PARRI		Lobster / Shrimp	5.358	0.0042		0.000005	5.84114E-12
SICYONIA STIMPSONI		Lobster / Shrimp	3.128	0.0025		0.000003	3.41006E-12
SICYONIA TYPICA		Lobster / Shrimp	0.004	0.0000		0.000000	4.36069E-15
		Lobster / Shrimp	2.221	0.0018		0.000002	2.42127E-12
HYMENOPENAEUS		Lobster / Shrimp	4.086	0.0032		0.000004	4.45444E-12
MESOPENAEUS TROPICALIS		Lobster / Shrimp	0.001	0.0000		0.000000	1.09017E-15
PLEOTICUS ROBUSTUS		Lobster / Shrimp	0.045	0.0000		0.000000	4.90577E-14
SOLENOCERA		Lobster / Shrimp	0.016	0.0000		0.000000	1.74428E-14
SOLENOCERA ACUMINATA		Lobster / Shrimp	11.939	0.0094		0.000010	1.30156E-11
SOLENOCERA ATLANTIDIS		Lobster / Shrimp	1.548	0.0012		0.000001	1.68759E-12
SOLENOCERA NECOPINA		Lobster / Shrimp	458.138	0.3619		0.000398	4.99449E-10
SOLENOCERA NECOPINA		Lobster / Shrimp	912.215	0.7206		0.000793	9.94471E-10
SOLENOCERA VIOSCAI		Lobster / Shrimp	0.03	0.0000		0.000000	3.27052E-14
STENOPUS		Lobster / Shrimp	0.121	0.0001		0.000000	1.31911E-13
STENOPUS SCUTELLATUS		Lobster / Shrimp	0.006	0.0000		0.000000	6.54103E-15
		Lobster / Shrimp	0.705	0.0006		0.000001	7.68571E-13
UPOGEBIA AFFINIS		Lobster / Shrimp	8.539	0.0067		0.000007	9.30898E-12
HEMIGRAPSUS		Lobster / Shrimp	0.154	0.0001		0.000000	1.67887E-13
ACTAEA		Lobster / Shrimp	0.002	0.0000		0.000000	2.18034E-15
ACTAEA RUFOPUNCTATA		Lobster / Shrimp	0.017	0.0000		0.000000	1.85329E-14
CARPOPORUS PAPULOSUS		Lobster / Shrimp	0.026	0.0000		0.000000	2.83445E-14
GLYPTOXANTHUS EROSUS		Lobster / Shrimp	0.016	0.0000		0.000000	1.74428E-14
MICROPANOPE		Lobster / Shrimp	0.045	0.0000		0.000000	4.90577E-14

MICROPANOPE NUTTINGII		Lobster / Shrimp	0.282	0.0002		0.000000	3.07429E-13
MICROPANOPE SCULPTIPES		Lobster / Shrimp	0.049	0.0000		0.000000	5.34184E-14
PSEUDOMEDAEUS AGASSIZII		Lobster / Shrimp	0.002	0.0000		0.000000	2.18034E-15
XANTHIDAE		Lobster / Shrimp	11.596	0.0092		0.000010	1.26416E-11
XANTHIDAE		Lobster / Shrimp	3.894	0.0031		0.000003	4.24513E-12
CARIDEA		Lobster / Shrimp	32.622	0.0258		0.000028	3.55636E-11
CARIDEA		Lobster / Shrimp	0.045	0.0000		0.000000	4.90577E-14
DECAPODA		Lobster / Shrimp	3.451	0.0027		0.000003	3.76218E-12
DECAPODA		Lobster / Shrimp	0.049	0.0000		0.000000	5.34184E-14
MESORHEA SEXSPINOSA		Lobster / Shrimp	0.006	0.0000		0.000000	6.54103E-15
PAGUROIDEA		Lobster / Shrimp	0.013	0.0000		0.000000	1.41722E-14
REPTANTIA		Lobster / Shrimp	2.173	0.0017		0.000002	2.36894E-12
STENOTHOIDAE		Lobster / Shrimp	100255.7	79.1988		0.087119	1.09296E-07
AEGA		Lobster / Shrimp	0.008	0.0000		0.000000	8.72138E-15
BATHYNOMUS		Lobster / Shrimp	1.724	0.0014		0.000001	1.87946E-12
BATHYNOMUS GIGANTEUS		Lobster / Shrimp	31.499	0.0249		0.000027	3.43393E-11
CIROLANA		Lobster / Shrimp	0.045	0.0000		0.000000	4.90577E-14
CIROLANA		Lobster / Shrimp	0.012	0.0000		0.000000	1.30821E-14
NEROCILA		Lobster / Shrimp	0.006	0.0000		0.000000	6.54103E-15
NEROCILA ACUMINATA		Lobster / Shrimp	0.128	0.0001		0.000000	1.39542E-13
CYMOTHOIDAE		Lobster / Shrimp	0.478	0.0004		0.000000	5.21102E-13
LIRONECA		Lobster / Shrimp	0.048	0.0000		0.000000	5.23283E-14
LIRONECA OVALIS		Lobster / Shrimp	0.002	0.0000		0.000000	2.18034E-15
LIRONECA REDMANNI		Lobster / Shrimp	0.022	0.0000		0.000000	2.39838E-14
OLENCIRA PRAEGUSTATOR		Lobster / Shrimp	23.076	0.0182		0.000020	2.51568E-11
ISOPODA		Lobster / Shrimp	0.142	0.0001		0.000000	1.54804E-13
GNATHOPHAUSIA GRACILIS		Lobster / Shrimp	0.068	0.0001		0.000000	7.41317E-14
LOPHOGASTER LONGIROSTRIS		Lobster / Shrimp	1	0.0008		0.000001	1.09017E-12
LOPHOGASTRIDAE		Lobster / Shrimp	151.481	0.1197		0.000132	1.6514E-10
MYSIDAE		Lobster / Shrimp	0.001	0.0000		0.000000	1.09017E-15
MYSIDAE		Lobster / Shrimp	0.227	0.0002		0.000000	2.47469E-13
GONODACTYLUS		Lobster / Shrimp	0.096	0.0001		0.000000	1.04657E-13
GONODACTYLUS BREDINI		Lobster / Shrimp	0.006	0.0000		0.000000	6.54103E-15
GONODACTYLUS OERSTEDII		Lobster / Shrimp	0.009	0.0000		0.000000	9.81155E-15
GONODACTYLUS OERSTEDII		Lobster / Shrimp	0.046	0.0000		0.000000	5.01479E-14
LYSIOSQUILLA		Lobster / Shrimp	4.354	0.0034		0.000004	4.74661E-12

LYSIOSQUILLA SCABRICAUDA		Lobster / Shrimp	0.06	0.0000		0.000000	6.54103E-14
PARASQUILLA		Lobster / Shrimp	0.03	0.0000		0.000000	3.27052E-14
PARASQUILLA COCCINEA		Lobster / Shrimp	45.105	0.0356		0.000039	4.91722E-11
PSEUDOSQUILLA CILIATA		Lobster / Shrimp	28.484	0.0225		0.000025	3.10525E-11
MEIOSQUILLA		Lobster / Shrimp	0.008	0.0000		0.000000	8.72138E-15
MEIOSQUILLA QUADRIDENS		Lobster / Shrimp	0.1	0.0001		0.000000	1.09017E-13
SQUILLA		Lobster / Shrimp	4.12	0.0033		0.000004	4.49151E-12
SQUILLA BRASILIENSIS		Lobster / Shrimp	1161.637	0.9177		0.001009	1.26638E-09
SQUILLA CHYDAEA		Lobster / Shrimp	0.637	0.0005		0.000001	6.9444E-13
SQUILLA DECEPTRIX		Lobster / Shrimp	0.565	0.0004		0.000000	6.15947E-13
SQUILLA EDENTATA		Lobster / Shrimp	5032.6	3.9756		0.004373	5.4864E-09
SQUILLA EMPUSA		Lobster / Shrimp	0.135	0.0001		0.000000	1.47173E-13
SQUILLA LIJDINGI		Lobster / Shrimp	9.861	0.0078		0.000009	1.07502E-11
SQUILLA NEGLECTA		Lobster / Shrimp	2.722	0.0022		0.000002	2.96745E-12
SQUILLA RUGOSA		Lobster / Shrimp	1969.399	1.5558		0.001711	2.14698E-09
SQUILLIDAE		Lobster / Shrimp	0.064	0.0001		0.000000	6.9771E-14
		Lobster / Shrimp	0.041	0.0000		0.000000	4.46971E-14
		Lobster / Shrimp	0.029	0.0000		0.000000	3.1615E-14
BALAMUS TRIGONUS		Lobster / Shrimp	1.519	0.0012		0.000001	1.65597E-12
PALLENOPSIS SCHMIDTI		Lobster / Shrimp	2.536	0.0020		0.000002	2.76468E-12
ANOPLODACTYLUS		Lobster / Shrimp	0.001	0.0000		0.000000	1.09017E-15
ANOPLODACTYLUS LENTUS		Lobster / Shrimp	0.029	0.0000		0.000000	3.1615E-14
PHOXICHILIDIIDAE		Lobster / Shrimp	0.022	0.0000		0.000000	2.39838E-14
ARTHROPODA		Lobster / Shrimp	0.011	0.0000		0.000000	1.19919E-14
CRUSTACEA(INFRAORDER)		Lobster / Shrimp	0.004	0.0000		0.000000	4.36069E-15
CRUSTACEA(INFRAORDER)		Lobster / Shrimp	0.001	0.0000		0.000000	1.09017E-15
CRUSTACEA(INFRAORDER) ANOMURA		Lobster / Shrimp	3.035	0.0024		0.000003	3.30867E-12
CRUSTACEA(INFRAORDER) BRACHYURA		Lobster / Shrimp	0.151	0.0001		0.000000	1.64616E-13
UNID CRUSTA		Lobster / Shrimp	0.432	0.0003		0.000000	4.70954E-13
		Lobster / Shrimp	**234459.9**	**185.2157**	**0**	**0.203737**	**2.55602E-07**
Actinopyga agassizi	LC	Sea Cucumbers		0.0000		0.000000	0
Amphigymnas bahamensis	LC	Sea Cucumbers		0.0000		0.000000	0
Astichopus multifidus	LC	Sea Cucumbers		0.0000		0.000000	0
Bathyplotes bigelowi	DD	Sea Cucumbers		0.0000		0.000000	0
Bathyplotes natans	LC	Sea Cucumbers		0.0000		0.000000	0
Bathyplotes pourtalesii	LC	Sea Cucumbers		0.0000		0.000000	0
Holothuria arenicola	DD	Sea Cucumbers		0.0000		0.000000	0

Holothuria cubana	LC	Sea Cucumbers		0.0000		0.000000	0
Holothuria dakarensis	LC	Sea Cucumbers		0.0000		0.000000	0
Holothuria floridana	LC	Sea Cucumbers		0.0000		0.000000	0
Holothuria glaberrima	LC	Sea Cucumbers		0.0000		0.000000	0
Holothuria grisea	LC	Sea Cucumbers		0.0000		0.000000	0
Holothuria impatiens	DD	Sea Cucumbers		0.0000		0.000000	0
Holothuria lentiginosa	LC	Sea Cucumbers	0.005	0.0000		0.000000	5.45086E-15
Holothuria mammata	LC	Sea Cucumbers		0.0000		0.000000	0
Holothuria mexicana	LC	Sea Cucumbers		0.0000		0.000000	0
Holothuria occidentalis	LC	Sea Cucumbers		0.0000		0.000000	0
Holothuria parvula	LC	Sea Cucumbers		0.0000		0.000000	0
Holothuria rowei	DD	Sea Cucumbers		0.0000		0.000000	0
Holothuria surinamensis	LC	Sea Cucumbers		0.0000		0.000000	0
Holothuria thomasi	LC	Sea Cucumbers		0.0000		0.000000	0
Mesothuria intestinalis	LC	Sea Cucumbers		0.0000		0.000000	0
Mesothuria lactea	LC	Sea Cucumbers		0.0000		0.000000	0
Mesothuria verrilli	DD	Sea Cucumbers		0.0000		0.000000	0
Paelopatides gigantea	DD	Sea Cucumbers		0.0000		0.000000	0
Parastichopus regalis	LC	Sea Cucumbers		0.0000		0.000000	0
PROTANKYRA GRAYI		Sea Cucumbers	0.045	0.0000		0.000000	4.90577E-14
CUCUMARIIDAE		Sea Cucumbers	43.306	0.0342		0.000038	4.7211E-11
EUTHYONACTA SOLIDA		Sea Cucumbers	2.217	0.0018		0.000002	2.41691E-12
OCNUS PYGMAEUS		Sea Cucumbers	0.005	0.0000		0.000000	5.45086E-15
THYONELLA GEMMATA		Sea Cucumbers	0.008	0.0000		0.000000	8.72138E-15
THYONELLA PERVICAX		Sea Cucumbers	0.003	0.0000		0.000000	3.27052E-15
		Sea Cucumbers	0.064	0.0001		0.000000	6.9771E-14
ALLOTHYONE MEXICANA		Sea Cucumbers	14.771	0.0117		0.000013	1.61029E-11
HOLOTHURIA		Sea Cucumbers	756.336	0.5975		0.000657	8.24536E-10
PARACAUDINA CHILENSIS_OBESACAUDA		Sea Cucumbers	0.004	0.0000		0.000000	4.36069E-15
MOLPADIA		Sea Cucumbers	1.221	0.0010		0.000001	1.3311E-12
MOLPADIA BARBOURI		Sea Cucumbers	3.356	0.0027		0.000003	3.65862E-12
MOLPADIA CUBANA		Sea Cucumbers	4.867	0.0038		0.000004	5.30587E-12
MOLPADIIDAE		Sea Cucumbers	0.042	0.0000		0.000000	4.57872E-14
		Sea Cucumbers	1.046	0.0008		0.000001	1.14032E-12
CAUDINA ARENATA		Sea Cucumbers	0.495	0.0004		0.000000	5.39635E-13
ISOSTICHOPUS		Sea Cucumbers	228.109	0.1802		0.000198	2.48678E-10
ISOSTICHOPUS BADIONOTUS		Sea Cucumbers	0.048	0.0000		0.000000	5.23283E-14
STICHOPUS		Sea Cucumbers	0.011	0.0000		0.000000	1.19919E-14
		Sea Cucumbers	**1055.959**	**0.8342**	**0**	**0.000918**	**1.15118E-09**
TUBIFICIDAE		Polychetes	2.531	0.0020		0.000002	2.75923E-12

HIRUDINEA		Polychetes	0.005	0.0000		0.000000	5.45086E-15
AMPHINOMIDAE		Polychetes	0.098	0.0001		0.000000	1.06837E-13
CHLOEIA		Polychetes	0.067	0.0001		0.000000	7.30415E-14
CHLOEIA VIRIDIS		Polychetes	0.079	0.0001		0.000000	8.61236E-14
HERMODICE		Polychetes	0.789	0.0006		0.000001	8.60146E-13
HERMODICE CARUNCULATA		Polychetes	0.02	0.0000		0.000000	2.18034E-14
CHAETOPTERUS		Polychetes	0.018	0.0000		0.000000	1.96231E-14
CHAETOPTERUS		Polychetes	0.372	0.0003		0.000000	4.05544E-13
SERPULIDAE		Polychetes	0.009	0.0000		0.000000	9.81155E-15
PHYLLODOCIDAE		Polychetes	0.004	0.0000		0.000000	4.36069E-15
DIOPATRA CUPREA		Polychetes	4.386	0.0035		0.000004	4.7815E-12
EUNICIDAE		Polychetes	0.608	0.0005		0.000001	6.62825E-13
ARCHIANNELIDA		Polychetes	0.045	0.0000		0.000000	4.90577E-14
APHRODITA		Polychetes	0.081	0.0001		0.000000	8.83039E-14
APHRODITA		Polychetes	0.809	0.0006		0.000001	8.81949E-13
HESIONIDAE		Polychetes	0.472	0.0004		0.000000	5.14561E-13
NEREIDAE		Polychetes	0.001	0.0000		0.000000	1.09017E-15
NEREIDAE		Polychetes	0.001	0.0000		0.000000	1.09017E-15
POLYNOIDAE		Polychetes	1.581	0.0012		0.000001	1.72356E-12
SYLLIDAE		Polychetes	0.057	0.0000		0.000000	6.21398E-14
NOTOMASTUS		Polychetes	0.045	0.0000		0.000000	4.90577E-14
MALDANIDAE		Polychetes	0.005	0.0000		0.000000	5.45086E-15
TEREBELLIDAE		Polychetes	0.002	0.0000		0.000000	2.18034E-15
DINOPHILIDAE		Polychetes	10.213	0.0081		0.000009	1.11339E-11
ANNELIDA		Polychetes	0.005	0.0000		0.000000	5.45086E-15
ANNELIDA		Polychetes	0.003	0.0000		0.000000	3.27052E-15
POLYCHAETA		Polychetes	109.887	0.0868		0.000095	1.19796E-10
POLYCHAETA SEDENTARIA		Polychetes	20.447	0.0162		0.000018	2.22908E-11
		Polychetes	**152.64**	**0.1206**	**0**	**0.000133**	**1.66404E-10**
BUGULA NERITINA		Bryozoans	0.1	0.0001		0.000000	1.09017E-13
SCHIZOPORELLA		Bryozoans	10.709	0.0085		0.000009	1.16747E-11
SCORPIONIDA		Bryozoans	223.409	0.1765		0.000194	2.43554E-10
ALCYONIDIIDAE		Bryozoans	0.063	0.0000		0.000000	6.86808E-14
ALCYONIDIIDAE		Bryozoans	0.412	0.0003		0.000000	4.49151E-13
AMATHIA ALTERNATA		Bryozoans	5.257	0.0042		0.000005	5.73104E-12
ZOOBOTRYON		Bryozoans	42.076	0.0332		0.000037	4.58701E-11
ZOOBOTRYON VERTICILLATUM		Bryozoans	100.966	0.0798		0.000088	1.1007E-10
		Bryozoans	0.87	0.0007		0.000001	9.4845E-13
BRYOZOA		Bryozoans	28.118	0.0222		0.000024	3.06535E-11
BRYOZOA ALGAE		Bryozoans	0.021	0.0000		0.000000	2.28936E-14
ECTOPROCTA		Bryozoans	0.045	0.0000		0.000000	4.90577E-14

		Bryozoans	**412.046**	**0.3255**	**0**	**0.000358**	**4.49201E-10**
AMAROUCIUM		Tunicates	0.966	0.0008		0.000001	1.05311E-12
AMAROUCIUM STELLATUM		Tunicates	0.057	0.0000		0.000000	6.21398E-14
MOLGULA		Tunicates	0.131	0.0001		0.000000	1.42813E-13
MOLGULA MANHATTENSIS		Tunicates	0.005	0.0000		0.000000	5.45086E-15
MOLGULA OCCIDENTALIS		Tunicates	8.488	0.0067		0.000007	9.25338E-12
		Tunicates	0.018	0.0000		0.000000	1.96231E-14
ASCIDIA		Tunicates	109.975	0.0869		0.000096	1.19892E-10
ASCIDIA NIGRA		Tunicates	3.162	0.0025		0.000003	3.44712E-12
ASCIDIIDAE		Tunicates	2.64	0.0021		0.000002	2.87805E-12
ASCIDIIDAE		Tunicates	0.004	0.0000		0.000000	4.36069E-15
PLEUROGONA		Tunicates	0.2	0.0002		0.000000	2.18034E-13
STYELA		Tunicates	66.067	0.0522		0.000057	7.20244E-11
STYELA PLICATA		Tunicates	85.72	0.0677		0.000074	9.34496E-11
STYELIDAE		Tunicates	5.987	0.0047		0.000005	6.52686E-12
STYELIDAE		Tunicates	0.01	0.0000		0.000000	1.09017E-14
PYROSOMA		Tunicates	32.045	0.0253		0.000028	3.49346E-11
PYROSOMA		Tunicates	742.924	0.5869		0.000646	8.09915E-10
SALPA		Tunicates	1.346	0.0011		0.000001	1.46737E-12
SALPA		Tunicates	1.578	0.0012		0.000001	1.72029E-12
SALPIDAE		Tunicates	0.207	0.0002		0.000000	2.25666E-13
SALPIDAE		Tunicates	0.771	0.0006		0.000001	8.40523E-13
TUNICATA		Tunicates	14.244	0.0113		0.000012	1.55284E-11
TUNICATA		Tunicates	0.006	0.0000		0.000000	6.54103E-15
		Tunicates	**1076.551**	**0.8504**	**0**	**0.000935**	**1.17363E-09**
GASTROTRICHA		Lancelets & Gastrotrichs	0.894	0.0007		0.000001	9.74614E-13
BRANCHIOSTOMA BERMUDAE		Lancelets & Gastrotrichs	0.18	0.0001		0.000000	1.96231E-13
		Lancelets & Gastrotrichs	**1.074**	**0.0008**	**0**	**0.000001**	**1.17084E-12**
CUBOMEDUSAE		Jellyfish	11.397	0.0090		0.000010	1.24247E-11
TAMOYA HAPLONEMA		Jellyfish	0.007	0.0000		0.000000	7.63121E-15
		Jellyfish	1.242	0.0010		0.000001	1.35399E-12
CHIROPSALMUS QUADRUMANUS		Jellyfish	0.341	0.0003		0.000000	3.71749E-13
BOUGAINVILLIDAE		Jellyfish	0.055	0.0000		0.000000	5.99595E-14
NEMOPSIS BACHEI		Jellyfish	13.501	0.0107		0.000012	1.47184E-11
HYDRACTINIA		Jellyfish	1.717	0.0014		0.000001	1.87183E-12
VELELLA VELELLA		Jellyfish	0.154	0.0001		0.000000	1.67887E-13
LEPTOMEDUSAE		Jellyfish	0.532	0.0004		0.000000	5.79972E-13

AEQUOREA		Jellyfish	4.849	0.0038		0.000004	5.28625E-12
AEQUOREA AEQUOREA		Jellyfish	4.086	0.0032		0.000004	4.45444E-12
RHACOSTOMA ATLANTICUM		Jellyfish	0.029	0.0000		0.000000	3.1615E-14
		Jellyfish	0.2	0.0002		0.000000	2.18034E-13
CAMPANULARIDAE		Jellyfish	0.001	0.0000		0.000000	1.09017E-15
PHYSALIA PELAGICA		Jellyfish	0.391	0.0003		0.000000	4.26257E-13
PHYSALIA PHYSALIS		Jellyfish	6.58	0.0052		0.000006	7.17333E-12
CASSIOPEA		Jellyfish	8.454	0.0067		0.000007	9.21632E-12
CASSIOPEA XAMACHAMA		Jellyfish	0.008	0.0000		0.000000	8.72138E-15
PHYLLORHIZA PUNCTATA		Jellyfish	0.051	0.0000		0.000000	5.55988E-14
RHOPILEMA VERRILLI		Jellyfish	10.91	0.0086		0.000009	1.18938E-11
STOMOLOPHUS MELEAGRIS		Jellyfish	6.078	0.0048		0.000005	6.62607E-12
		Jellyfish	0.084	0.0001		0.000000	9.15745E-14
CYANEA CAPILLATA		Jellyfish	1.541	0.0012		0.000001	1.67996E-12
CYANEIDAE		Jellyfish	0.004	0.0000		0.000000	4.36069E-15
DRYMONEMA		Jellyfish	87.718	0.0693		0.000076	9.56277E-11
DRYMONEMA DALMATINA		Jellyfish	0.371	0.0003		0.000000	4.04454E-13
CHRYSAORA		Jellyfish	138.508	0.1094		0.000120	1.50998E-10
CHRYSAORA QUINQUECIRRHA		Jellyfish	0.022	0.0000		0.000000	2.39838E-14
DACTYLOMETRA QUINQUECIRRHA		Jellyfish	6.79	0.0054		0.000006	7.40227E-12
AURELIA AURITA		Jellyfish	35035.05	27.6765		0.030444	3.81942E-08
AURELIA AURITA		Jellyfish	7984.504	6.3075		0.006938	8.70448E-09
SEMAEOSTOMAE		Jellyfish	2.484	0.0020		0.000002	2.70799E-12
SEMAEOSTOMAE		Jellyfish	0.074	0.0001		0.000000	8.06727E-14
SCYPHOZOA		Jellyfish	936.299	0.7396		0.000814	1.02073E-09
SCYPHOZOA		Jellyfish	657.634	0.5195		0.000571	7.16934E-10
CNIDARIA		Jellyfish	3.351	0.0026		0.000003	3.65317E-12
		Jellies	**44925.02**	**35.4893**	**0**	**0.039038**	**4.8976E-08**
COELENTERATA		Ctenopphores	5.964	0.0047		0.000005	6.50179E-12
BEROE OVATA		Ctenopphores	10.479	0.0083		0.000009	1.14239E-11
BEROIDA		Ctenopphores	0.953	0.0008		0.000001	1.03893E-12
MNEMIOPSIS MCCRADYI		Ctenopphores	1.65	0.0013		0.000001	1.79878E-12
		Ctenopphores	57.15	0.0451		0.000050	6.23033E-11
MNEMIIDAE		Ctenopphores	44.989	0.0355		0.000039	4.90458E-11
CTENOPHORA		Ctenopphores	11.348	0.0090		0.000010	1.23713E-11
		Cetnophores	**132.533**	**0.1047**	**0**	**0.000115**	**1.44484E-10**
BRISINGIDAE		Sea Stars	10.446	0.0083		0.000009	1.13879E-11
ASTERIAS		Sea Stars	0.055	0.0000		0.000000	5.99595E-14
CHEIRASTER ECHINULATUS		Sea Stars	27.125	0.0214		0.000024	2.95709E-11

ASTROPECTEN		Sea Stars	2.252	0.0018		0.000002	2.45507E-12
ASTROPECTEN		Sea Stars	57.024	0.0450		0.000050	6.2166E-11
ASTROPECTEN ALLIGATOR		Sea Stars	0.172	0.0001		0.000000	1.8751E-13
ASTROPECTEN AMERICANUS		Sea Stars	1.2	0.0009		0.000001	1.30821E-12
ASTROPECTEN ANTILLENSIS		Sea Stars	0.354	0.0003		0.000000	3.85921E-13
ASTROPECTEN ARMATUS		Sea Stars	0.05	0.0000		0.000000	5.45086E-14
ASTROPECTEN ARTICULATUS		Sea Stars	16.481	0.0130		0.000014	1.79671E-11
ASTROPECTEN CINGULATUS		Sea Stars	912.905	0.7212		0.000793	9.95224E-10
ASTROPECTEN COMPTUS		Sea Stars	1.175	0.0009		0.000001	1.28095E-12
ASTROPECTEN DUPLICATUS		Sea Stars	138.436	0.1094		0.000120	1.50919E-10
PERSEPHONASTER		Sea Stars	0.001	0.0000		0.000000	1.09017E-15
PLUTONASTER RIGIDUS		Sea Stars	0.048	0.0000		0.000000	5.23283E-14
TETHYASTER		Sea Stars	82.054	0.0648		0.000071	8.9453E-11
TETHYASTER GRANDIS		Sea Stars	0.027	0.0000		0.000000	2.94346E-14
LUIDIA		Sea Stars	23.823	0.0188		0.000021	2.59712E-11
LUIDIA ALTERNATA		Sea Stars	0.004	0.0000		0.000000	4.36069E-15
LUIDIA BARBADENSIS		Sea Stars	410.786	0.3245		0.000357	4.47827E-10
LUIDIA CLATHRATA		Sea Stars	0.018	0.0000		0.000000	1.96231E-14
LUIDIA ELEGANS		Sea Stars	0.215	0.0002		0.000000	2.34387E-13
LUIDIA LUDWIGI SCOTTI		Sea Stars	54.349	0.0429		0.000047	5.92498E-11
LUIDIA SAGAMINA ACICULATA		Sea Stars	1.711	0.0014		0.000001	1.86528E-12
LUIDIA SENEGALENSIS		Sea Stars	0.027	0.0000		0.000000	2.94346E-14
		Sea Stars	0.151	0.0001		0.000000	1.64616E-13
ECHINASTER		Sea Stars	0.933	0.0007		0.000001	1.01713E-12
ECHINASTER MODESTUS		Sea Stars	0.527	0.0004		0.000000	5.74521E-13
ECHINASTER PAUCISPINUS		Sea Stars	4.079	0.0032		0.000004	4.44681E-12
ECHINASTER SENTUS		Sea Stars	1.798	0.0014		0.000002	1.96013E-12
ECHINASTER SERPENTARIUS		Sea Stars	3.471	0.0027		0.000003	3.78399E-12
ECHINASTER SPINULOSUS		Sea Stars	0.006	0.0000		0.000000	6.54103E-15
ECHINASTERIDAE		Sea Stars	0.406	0.0003		0.000000	4.4261E-13
HENRICI		Sea Stars	0.017	0.0000		0.000000	1.85329E-14
HENRICI ANTILLARUM		Sea Stars	268.243	0.2119		0.000233	2.92431E-10
THYRASTER SERPENTARIUS		Sea Stars	0.004	0.0000		0.000000	4.36069E-15
CHAETASTER NODOSUS		Sea Stars	0.025	0.0000		0.000000	2.72543E-14
ANTHENOIDES PEIRCEI		Sea Stars	7.033	0.0056		0.000006	7.66718E-12
GONIASTER		Sea Stars	0.2	0.0002		0.000000	2.18034E-13
GONIASTER AMERICANUS		Sea Stars	0.168	0.0001		0.000000	1.83149E-13
GONIASTER AMERICANUS		Sea Stars	13.197	0.0104		0.000011	1.4387E-11
GONIASTER TESSELATUS		Sea Stars	0.178	0.0001		0.000000	1.94051E-13
MEDIASTER BAIRDI		Sea Stars	2.667	0.0021		0.000002	2.90749E-12
MEDIASTER PEDICELLARIS		Sea Stars	0.011	0.0000		0.000000	1.19919E-14
NYMPHASTER		Sea Stars	0.16	0.0001		0.000000	1.74428E-13

PLINTHASTER DENTATUS		Sea Stars	0.193	0.0002		0.000000	2.10403E-13
ODONASTER		Sea Stars	13.608	0.0107		0.000012	1.48351E-11
NARCISSIA		Sea Stars	8.081	0.0064		0.000007	8.80968E-12
NARCISSIA TRIGONARIA		Sea Stars	0.082	0.0001		0.000000	8.93941E-14
NASSARIUS ACUTUS		Sea Stars	0.159	0.0001		0.000000	1.73337E-13
NASSARIUS AMBIGUUS		Sea Stars	0.106	0.0001		0.000000	1.15558E-13
NASSARIUS VIBEX		Sea Stars	0.003	0.0000		0.000000	3.27052E-15
OPHIDIASTERIDAE		Sea Stars	0.033	0.0000		0.000000	3.59757E-14
OREASTER RETICULATUS		Sea Stars	0.756	0.0006		0.000001	8.2417E-13
ASTEROIDEA		Sea Stars	6.036	0.0048		0.000005	6.58028E-12
ASTEROIDEA		Sea Stars	571.623	0.4516		0.000497	6.23168E-10
ANTEDONIDAE		Sea Stars	0.002	0.0000		0.000000	2.18034E-15
COMACTINIA		Sea Stars	1.026	0.0008		0.000001	1.11852E-12
COMACTINIA MERIDIONALIS		Sea Stars	0.002	0.0000		0.000000	2.18034E-15
COMASTERIDAE		Sea Stars	0.1	0.0001		0.000000	1.09017E-13
CRINOIDEA		Sea Stars	0.121	0.0001		0.000000	1.31911E-13
CRINOIDEA		Sea Stars	0.153	0.0001		0.000000	1.66796E-13
AMPHIODIA ATRA		Sea Stars	0.009	0.0000		0.000000	9.81155E-15
OPHIOSTIGMA ISOCANTHA		Sea Stars	2.308	0.0018		0.000002	2.51612E-12
HEMIPHOLIS ELONGATA		Sea Stars	1.073	0.0008		0.000001	1.16975E-12
OPHIACTIDAE		Sea Stars	1.115	0.0009		0.000001	1.21554E-12
OPHIOLEPIS		Sea Stars	18.44	0.0146		0.000016	2.01028E-11
OPHIOLEPIS ELEGANS		Sea Stars	0.012	0.0000		0.000000	1.30821E-14
		Sea Stars	0.027	0.0000		0.000000	2.94346E-14
ASTEROPORPA		Sea Stars	0.046	0.0000		0.000000	5.01479E-14
ASTEROPORPA ANNULATA		Sea Stars	3.989	0.0032		0.000003	4.3487E-12
ASTEROPORPA ANNULATA		Sea Stars	0.005	0.0000		0.000000	5.45086E-15
ASTROCYCLUS		Sea Stars	0.056	0.0000		0.000000	6.10496E-14
ASTROCYCLUS CAECILIA		Sea Stars	2.196	0.0017		0.000002	2.39402E-12
ASTROGORDIUS CACAOTICUM		Sea Stars	2.953	0.0023		0.000003	3.21928E-12
OPHIODERMA		Sea Stars	0.343	0.0003		0.000000	3.73929E-13
OPHIODERMA APPRESSUM		Sea Stars	0.148	0.0001		0.000000	1.61345E-13
OPHIODERMA BREVISPINUM		Sea Stars	0.356	0.0003		0.000000	3.88101E-13
OPHIODERMA DEVANEYI		Sea Stars	0.064	0.0001		0.000000	6.9771E-14
		Sea Stars	0.037	0.0000		0.000000	4.03364E-14
OPHIOMYXA		Sea Stars	0.013	0.0000		0.000000	1.41722E-14
OPHIOMYXA FLACCIDA		Sea Stars	0.019	0.0000		0.000000	2.07133E-14
OPHIURAE		Sea Stars	18.601	0.0147		0.000016	2.02783E-11
OPHIOPHOLIS		Sea Stars	0.01	0.0000		0.000000	1.09017E-14
OPHIONEREIS		Sea Stars	0.28	0.0002		0.000000	3.05248E-13
OPHIONEREIS RETICULATA		Sea Stars	0.057	0.0000		0.000000	6.21398E-14
OPHIOTHRIX		Sea Stars	1.014	0.0008		0.000001	1.10543E-12

OPHIOTHRIX ANGULATA		Sea Stars	0.097	0.0001		0.000000	1.05747E-13
		Sea Stars	0.002	0.0000		0.000000	2.18034E-15
OPHIURA		Sea Stars	0.819	0.0006		0.000001	8.92851E-13
OPHIURA		Sea Stars	0.141	0.0001		0.000000	1.53714E-13
GORGONOCEPHALIDAE		Sea Stars	1.237	0.0010		0.000001	1.34854E-12
GORGONOCEPHALUS ARCTICUS		Sea Stars	3.038	0.0024		0.000003	3.31194E-12
GORGONOCEPHALUS ARCTICUS		Sea Stars	0.299	0.0002		0.000000	3.25961E-13
EURYALINA		Sea Stars	0.001	0.0000		0.000000	1.09017E-15
ASTROPHYTON		Sea Stars	0.036	0.0000		0.000000	3.92462E-14
ASTROPHYTON MURICATUS		Sea Stars	27.06	0.0214		0.000024	2.95001E-11
OPHIUROIDEA		Sea Stars	0.032	0.0000		0.000000	3.48855E-14
ECHINODERMATA		Sea Stars	17.396	0.0137		0.000015	1.89646E-11
		Sea Stars	**2749.425**	**2.1720**	**0**	**0.002389**	**2.99735E-09**
ARBACIA PUNCTULATA		Sea Urchins	21.928	0.0173		0.000019	2.39053E-11
ARBACIA PUNCTULATA		Sea Urchins	0.277	0.0002		0.000000	3.01978E-13
COELOPLEURUS FLORIDANUS		Sea Urchins	0.01	0.0000		0.000000	1.09017E-14
CIDARIDAE		Sea Urchins	0.58	0.0005		0.000001	6.323E-13
EUCIDARIS		Sea Urchins	159.294	0.1258		0.000138	1.73658E-10
EUCIDARIS TRIBULOIDES		Sea Urchins	144.795	0.1144		0.000126	1.57851E-10
CLYPEASTER		Sea Urchins	304.894	0.2409		0.000265	3.32387E-10
CLYPEASTER		Sea Urchins	148.008	0.1169		0.000129	1.61354E-10
CLYPEASTER PROSTRATUS		Sea Urchins	262.162	0.2071		0.000228	2.85802E-10
CLYPEASTER RAVENELII		Sea Urchins	41.131	0.0325		0.000036	4.48399E-11
CLYPEASTER SUBDEPRESSUS		Sea Urchins	55.374	0.0437		0.000048	6.03672E-11
ECHINARACHNIUS		Sea Urchins	288.164	0.2276		0.000250	3.14148E-10
ECHINARACHNIUS PARMA		Sea Urchins	5.638	0.0045		0.000005	6.14639E-12
ECHINARACHNIUS PARMA		Sea Urchins	3.574	0.0028		0.000003	3.89628E-12
ENCOPE ABERRANS		Sea Urchins	52.65	0.0416		0.000046	5.73976E-11
ENCOPE MICHELINI		Sea Urchins	0.005	0.0000		0.000000	5.45086E-15
MELLITA		Sea Urchins	6.205	0.0049		0.000005	6.76452E-12
MELLITA		Sea Urchins	56.353	0.0445		0.000049	6.14345E-11
MELLITA QUINQUESPERFORATA		Sea Urchins	0.752	0.0006		0.000001	8.1981E-13
MELLITA SEXIESPERFORATA		Sea Urchins	8.806	0.0070		0.000008	9.60006E-12
MELLITA TESTUDINATA		Sea Urchins	0.333	0.0003		0.000000	3.63027E-13
SCUTELLIDAE		Sea Urchins	5.037	0.0040		0.000004	5.4912E-12
CENTROSTEPHANUS LONGISPINOSUS_RUBRICING		Sea Urchins	0.004	0.0000		0.000000	4.36069E-15
DIADEMA		Sea Urchins	0.399	0.0003		0.000000	4.34979E-13
DIADEMA		Sea Urchins	0.122	0.0001		0.000000	1.33001E-13
DIADEMA ANTILLARUM		Sea Urchins	1.5	0.0012		0.000001	1.63526E-12
ECHINOLAMPAS DEPRESSA		Sea Urchins	0.076	0.0001		0.000000	8.28531E-14
ECHINOLAMPODIDAE		Sea Urchins	3.021	0.0024		0.000003	3.29341E-12

BRISSOPSIS ALTA		Sea Urchins	24.293	0.0192		0.000021	2.64836E-11
BRISSOPSIS ALTA		Sea Urchins	1702.874	1.3452		0.001480	1.85643E-09
BRISSOPSIS ATLANTICA		Sea Urchins	0.535	0.0004		0.000000	5.83242E-13
MEOMA VENTRICOSA		Sea Urchins	2.227	0.0018		0.000002	2.42781E-12
MOIRA ATROPUS		Sea Urchins	0.195	0.0002		0.000000	2.12584E-13
SCHIZASTER		Sea Urchins	63.306	0.0500		0.000055	6.90144E-11
SCHIZASTER ORBIGNYANUS		Sea Urchins	1.572	0.0012		0.000001	1.71375E-12
		Sea Urchins	0.132	0.0001		0.000000	1.43903E-13
SPATANGIDAE		Sea Urchins	22.6	0.0179		0.000020	2.46379E-11
LYTECHINUS		Sea Urchins	283.124	0.2237		0.000246	3.08654E-10
LYTECHINUS VARIEGATUS		Sea Urchins	0.001	0.0000		0.000000	1.09017E-15
ECHINOIDEA		Sea Urchins	77.155	0.0609		0.000067	8.41122E-11
ECHINOIDEA		Sea Urchins	4.411	0.0035		0.000004	4.80875E-12
		Sea Urchins	**3753.517**	**2.9652**	**0**	**0.003262**	**4.09198E-09**
MOPALIA		Chitons	0.048	0.0000		0.000000	5.23283E-14
MOPALIIDAE		Chitons	0.257	0.0002		0.000000	2.80174E-13
ISOCHITON		Chitons	0.043	0.0000		0.000000	4.68774E-14
CHITON		Chitons	0.033	0.0000		0.000000	3.59757E-14
		Chitons	**0.381**	**0.0003**	**0**	**0.000000**	**4.15356E-13**
SIPUNCULIDAE		Worms	0.116	0.0001		0.000000	1.2646E-13
SIPUNCULIDAE		Worms	0.91	0.0007		0.000001	9.92057E-13
NEMATODA		Worms	0.024	0.0000		0.000000	2.61641E-14
NEMERTEA		Worms	0.1	0.0001		0.000000	1.09017E-13
CARYOPHYLLAEIDAE		Worms	0.002	0.0000		0.000000	2.18034E-15
CYATHOCEPHALIDAE		Worms	0.036	0.0000		0.000000	3.92462E-14
		Worms	**1.188**	**0.0009**	**0**	**0.000001**	**1.29512E-12**
SPECIOSPONGIA VESPARIA		Sponges	0.032	0.0000		0.000000	3.48855E-14
IRCINIA		Sponges	0.002	0.0000		0.000000	2.18034E-15
SPONGIIDAE		Sponges	3.943	0.0031		0.000003	4.29855E-12
SPONGIIDAE		Sponges	3.461	0.0027		0.000003	3.77309E-12
DONATIIDAE		Sponges	0.129	0.0001		0.000000	1.40632E-13
GEODIA		Sponges	1.795	0.0014		0.000002	1.95686E-12
GEODIA GIBBEROSA		Sponges	1.583	0.0013		0.000001	1.72574E-12
DEMOSPONGIAE		Sponges	0.042	0.0000		0.000000	4.57872E-14
PORIFERA		Sponges	664.462	0.5249		0.000577	7.24378E-10
PORIFERA		Sponges	0.254	0.0002		0.000000	2.76904E-13
		Sponges	**675.703**	**0.5338**	**0**	**0.000587**	**7.36633E-10**

APPENDIX G

HABITAT BUILDING SPECIES LIST AND ASSOCIATED DATA

Genus species	Global RL	Common Group	Functional Group
Millepora alcicornis	LC	Corals	Hard Corals
Millepora complanata	LC	Corals	Hard Corals
Halophila baillonii	VU	Seagrass	Mangroves / Seagrass
Halophila decipiens	LC	Seagrass	Mangroves / Seagrass
Halophila engelmanni	NT	Seagrass	Mangroves / Seagrass
Halophila johnsonii	LC	Seagrass	Mangroves / Seagrass
Thalassia testudinum	LC	Seagrass	Mangroves / Seagrass
Halodule beaudettei	DD	Manatee Grass	Mangroves / Seagrass
Halodule wrightii	LC	Manatee Grass	Mangroves / Seagrass
Syringodium filiforme	LC	Manatee Grass	Mangroves / Seagrass
Ruppia maritima	LC	Seagrass	Mangroves / Seagrass
Avicennia germinans	LC	Mangrove	Mangroves / Seagrass
Conocarpus erectus	LC	Mangrove	Mangroves / Seagrass
Laguncularia racemosa	LC	Mangrove	Mangroves / Seagrass
Rhizophora mangle	LC	Mangrove	Mangroves / Seagrass
Acrostichum aureum	LC	Ferns	Mangroves / Seagrass
Acrostichum danaeifolium	LC	Ferns	Mangroves / Seagrass
Acropora cervicornis	CR	Corals	Corals
Acropora palmata	CR	Corals	Corals
Agaricia agaricites	LC	Corals	Corals
Agaricia fragilis	DD	Corals	Corals
Agaricia grahamae	LC	Corals	Corals
Agaricia humilis	LC	Corals	Corals
Agaricia lamarcki	VU	Corals	Corals
Agaricia tenuifolia	NT	Corals	Corals
Agaricia undata	DD	Corals	Corals
Helioseris cucullata	LC	Corals	Corals
Leptoseris cailleti	LC	Corals	Corals
Madracis asperula	DD	Corals	Corals
Madracis auretenra	LC	Corals	Corals
Madracis decactis	LC	Corals	Corals
Madracis formosa	LC	Corals	Corals
Madracis pharensis	LC	Corals	Corals

Madracis senaria	LC	Corals	Corals
Stephanocoenia intersepta	LC	Corals	Corals
Cladocora arbuscula	LC	Corals	Corals
Colpophyllia natans	LC	Corals	Corals
Diploria clivosa	LC	Corals	Corals
Diploria labyrinthiformis	LC	Corals	Corals
Diploria strigosa	LC	Corals	Corals
Favia fragum	LC	Corals	Corals
Manicina areolata	LC	Corals	Corals
Montastraea annularis	EN	Corals	Corals
Montastraea cavernosa	LC	Corals	Corals
Montastraea faveolata	EN	Corals	Corals
Montastraea franksi	VU	Corals	Corals
Solenastrea bournoni	LC	Corals	Corals
Solenastrea hyades	LC	Corals	Corals
Dichocoenia stellaris	DD	Corals	Corals
Dichocoenia stokesii	VU	Corals	Corals
Eusmilia fastigiata	LC	Corals	Corals
Meandrina danae	LC	Corals	Corals
Meandrina meandrites	LC	Corals	Corals
Isophyllastrea rigida	LC	Corals	Corals
Isophyllia sinuosa	LC	Corals	Corals
Mussa angulosa	LC	Corals	Corals
Mycetophyllia aliciae	LC	Corals	Corals
Mycetophyllia danaana	LC	Corals	Corals
Mycetophyllia ferox	VU	Corals	Corals
Mycetophyllia lamarckiana	LC	Corals	Corals
Mycetophyllia reesi	DD	Corals	Corals
Scolymia cubensis	LC	Corals	Corals
Scolymia lacera	LC	Corals	Corals
Scolymia wellsi	DD	Corals	Corals
Oculina diffusa	LC	Corals	Corals
Oculina robusta	DD	Corals	Corals
Oculina tenella	DD	Corals	Corals
Oculina varicosa	VU	Corals	Corals
Porites astreoides	LC	Corals	Corals
Porites divaricata	LC	Corals	Corals
Porites furcata	LC	Corals	Corals
Porites porites	LC	Corals	Corals
Astrangia poculata	LC	Corals	Corals
Siderastrea radians	LC	Corals	Corals
Siderastrea siderea	LC	Corals	Corals

APPENDIX H

AUTHOR ACKNOWLEDGEMENT FOR INCLUSION

The following individuals contributed to the research contained within this manuscript and have given their permission for this work to be used in both published articles in addition to the preceding dissertation.

- Kyle Strongin
- Beth Polidoro
- Steven Saul
- Gina Ralph
- Christi Linardich
- Kent Carpenter
- Alana Lancaster
- Alfonso Aguilar-Perera
- Héctor Espinosa Pérez
- Daniel Perch
- Dorka Cobián Rojas
- Juliett González-Méndez
- Patricia González Díaz
- Susana Perera Valderrama
- Larry McKinney